Laparoscopic Versus Open Pyeloplasty for Pelvicoureteric Junction Obstruction: A Systematic Review and Meta-Analysis

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Abstract

Objectives To compare outcomes of laparoscopic versus open pyeloplasty for the management of pelvicoureteric junction obstruction (PUJO) using a systematic review and meta-analysis.

In September 2022, electronic database searches were conducted using the Cochrane Library, the Cochrane Central Register of Controlled Trials, EMBASE, MEDLINE, clinical trial registries, and relevant conferences to identify relevant abstracts and presentations.

Methods Prospective randomized controlled trials comparing laparoscopic to open pyeloplasty for PUJO were included in the review. There were no restrictions on date or language. All populations were included. The authors performed data extraction and risk of bias assessment using the risk of bias tool. Meta-analysis was performed using RevMan software.

Results Six prospective randomized controlled trials involving 335 participants were included in the analysis. Six studies included data on the failure rate, with a slight favouring of open pyeloplasty compared to laparoscopic pyeloplasty, although this was not statistically significant (odds ratio [OR], 1.39; 95% confidence interval [CI] 0.50 to 3.83).

Five studies compared operative time, with open pyeloplasty found to have shorter times across all studies (mean difference [MD], 54.97 minutes; 95% CI 47.08 to 62.85).

Based on 5 studies, laparoscopic pyeloplasty has a shorter hospital stay (MD, 4.12 days; 95% CI 3.64 to 4.59).

Two studies compared postoperative analgesia requirements, showing a lower diclofenac requirement in the laparoscopic group (MD, 330.08 mg; 95% CI 298.05 to 362.11 mg).

One study compared blood loss intraoperatively and found no significant difference between the groups (MD, 8.52 mL; 95% CI -2.49 to 19.53).

Based on 4 studies, laparoscopic pyeloplasty may result in slightly higher complication rates postoperatively (OR, 1.49; 95% CI 0.53 to 4.18); however, there was no statistically significant difference.

No subgroup analyses were conducted.

Conclusions Limited, low-quality evidence from small-scale trials suggests that laparoscopic pyeloplasty has improved outcomes in terms of shorter hospital stays and reduced postoperative pain compared to open pyeloplasty. Open pyeloplasty, on the other hand, had a shorter operative time. Failure rate, complication rate, and blood loss were comparable between the 2 approaches.

Key Words

Pyeloplasty, laparoscopy, minimally invasive surgical procedures, open surgery, pelvicoureteric junction obstruction

Competing Interests

None declared.

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Abbreviations

CI confidence interval
LP laparoscopic pyeloplasty
MD mean difference
OP open pyeloplasty
PUJO pelvicoureteric junction obstruction
RCTs randomized controlled trials
RR risk ratio

Introduction

Pelvicoureteric junction obstruction (PUJO) is a common cause of hydronephrosis in children and adults. The prevalence of this condition has risen recently due to the increased efficacy and hence widespread use of antenatal screening. Approximately one in 1000 newborns has PUJO, with a male predominance (2:1)[1]. PUJO is most frequently caused by a stenotic segment of the ureter at the pelvicoureteric junction (PUJ), creating a functional obstruction. Less common causes of pelvicoureteric junction obstruction include crossing vessels, fibrosis, anatomical variants, and fibroepithelial polyps[2]. In adults, acquired stenosis of the PUJ can be caused by upper tract infections, stones, trauma (such as instrumentation), or ischemia and can culminate in reactive fibrosis and an annular stricture. Upon presentation, symptoms typically include flank or abdominal pain due to increased pressure within the kidney, which can lead to kidney damage[3].

In approximately 60% to 70% of cases, patients do not require surgical management, with hydronephrosis resolving spontaneously[4]. However, patients who experience significant symptoms or impairment in renal function may require surgical management. Open pyeloplasty (OP) is considered the gold standard of treatment for symptomatic PUJO[5]. However, there has been a trend toward minimally invasive techniques with advancements in technology. Minimally invasive procedures such as robot-assisted laparoscopic pyeloplasty (LP) can theoretically improve efficiency and effectiveness[6]. These may include a reduced risk for significant bleeding, smaller incisions, decreased pain, improved cosmetic outcomes, lower risk for postoperative infections, and shorter hospital stays[7]. A study reported an increase in the use of minimally invasive pyeloplasty from 2.4% to 55.3% of all pyeloplasty procedures conducted between 1998 and 2009[8].

Despite the increasing popularity of laparoscopic approaches, there is a lack of high-quality evidence directly comparing OP to LP. Systematic reviews have been conducted comparing different laparoscopic approaches to pyeloplasty[9], LP versus OP in children[10], or LP versus robotic-assisted LP in infants[11], or have predominantly included retrospective studies[12]. To date, there has not been a systematic review of prospective studies comparing LP to OP. This systematic review aims to identify and analyze randomized controlled trials (RCTs) to assess the use of laparoscopic pyeloplasty in patients of all ages with PUJO.

Methods

Eligibility criteria

We included all prospective RCTs and excluded all other study designs. We evaluated laparoscopic pyeloplasty compared to open pyeloplasty in children and adults with a diagnosis of PULO who had not previously received any surgical management.

Information sources

In July 2022, we conducted electronic searches of the Cochrane Library and the Cochrane Central Register of Controlled Trials, MEDLINE, and EMBASE Ovid (see **Online Appendix 1** for search strategy), with no restrictions on date or language. We reviewed trials registries for unpublished studies, including the Australia and New Zealand Clinical Trials Registry, International Clinical Trials Registry (World Health Organization), and Clinicaltrials.gov. Additionally, we reached out to experts in urology to identify critical studies and ongoing research. We searched for abstracts presented at the European Association of Urology (EAU) annual meetings, the British Association of Urological Surgeons (BAUS), and the American Urological Association (AUA) between 2019 and 2021. We conducted a manual search of the reference lists of included studies to identify any additional research.

Selection process

Two authors (B.B. and T.S.) reviewed all identified studies using Rayyan, a software program designed to screen potential studies. All studies identified in the search strategy were screened by title and abstract. Two review authors (B.B. and T.S.) independently conducted a thorough evaluation of the full text of all potentially relevant studies and categorized them as excluded, included, ongoing, or awaiting classification. The authors documented reasons for excluding specific studies. In the case of any discrepancies between the authors, a third author (H.N.) was involved to discuss and adjudicate any inconsistencies. This process is highlighted in the PRISMA flow diagram. A Cohen's Unweighted Kappa score of 0.92 was calculated, indicating strong agreement between the reviewers and hence strong inter-rater reliability.

Data collection process/items

One author (B.B.) developed a dedicated data extraction form. Two authors (B.B. and S.H.) used this data extraction form to independently extract the following information. Any discrepancies not resolved between the 2 authors were adjudicated with the help of a third author (H.N.).

This review included all studies, regardless of whether they reported the outcomes of interest. The primary outcome assessed was the failure of pyeloplasty, while the secondary outcomes were length of stay, analgesia requirement, length of operation, estimated blood loss, surgical complications, and cosmetic appearance.

In addition to these outcomes of interest, data on various other variables was sought, including study design, protocol, country/context, language, dates of study, inclusion criteria of participants, exclusion criteria of participants, number of participants per group, experimental and control intervention, and funding source.

Study risk of bias assessment

Two authors (B.B. and S.H.) independently conducted a risk of bias assessment using the Cochrane Risk of Bias tool (RoB 1.0)[13]. Each author evaluated the criteria listed below as low risk, unclear risk, or high risk. Any discrepancies in judgment between the authors (B.B. and S.H.) were discussed and resolved, and a third author (T.S.) was introduced to adjudicate on any differences that remained unresolved.

Criteria assessed:

- Random sequence generation (selection bias)
- Allocation concealment (selection bias)
- Blinding of participants and personnel (performance bias)
- Blinding of outcome assessment (detection bias)
- Incomplete outcome data (attrition bias)
- Selective reporting (reporting bias)
- Other sources of bias

We evaluated selection bias on a trial-by-trial basis by examining the methods of randomization and allocation concealment. Similarly, we assessed performance bias on a trial-by-trial basis by examining the methods used to blind participants and personnel to the intervention received.

For each outcome within each trial, we assessed outcome and reporting bias. We then categorized the outcomes into objective (not susceptible to detection bias) and subjective (susceptible to detection bias).

We planned to perform a primary analysis using only the studies with a low risk of bias and then a sensitivity analysis.

Effect measures and synthesis methods

We reported continuous outcome data measures as mean differences (MDs) with 95% confidence intervals (95% CI) and dichotomous outcome measures as a risk ratio (RR) with 95% CI. Given the difference in populations, paediatric and adult populations were synthesized separately.

We summarized the data using a random effects model and interpreted the results by considering the whole distribution of effects in the random-effects meta-analyses. Additionally, our statistical analyses followed the guidelines outlined the Cochrane Handbook for Systematic Reviews of Interventions. For dichotomous outcomes, we used the Mantel-Haenszel method; for continuous outcomes, we used the inverse variance method. We used Review Manager 5 (RevMan 5) software to perform all the analyses.

Missing data: We had planned to contact the study authors for any missing data and intended to use an intention-to-treat analysis. However, no missing data were reported, and thus no imputation was necessary by the authors.

Statistical heterogeneity: We assessed heterogeneity both graphically, by interpreting forest plots, and statistically using the I2 statistic. A value of I2 over 75% indicated significant heterogeneity between studies.

Subgroup analysis: No subgroup analysis was planned.

Certainty assessment

The employed the GRADE approach to assess the quality of evidence generated by this systematic review. The GRADE Guideline Development Tool was used to make the summary of findings table.

Results

The initial search strategy identified 1561 records from electronic databases, with an additional 8 records were identified from conference abstracts and 22 from citation searching of other sources (**Figure 1**). After removing duplicates, we screened 1168 records, excluding 1010 based on the title and abstract screening. We screened 158 full articles for suitability. Of these, 119 were excluded due to incorrect study type and 34 were excluded due to wrong intervention. We included 5 studies based on eligibility criteria and identified an additional study (Garg 2014[14]) through other searching methods.

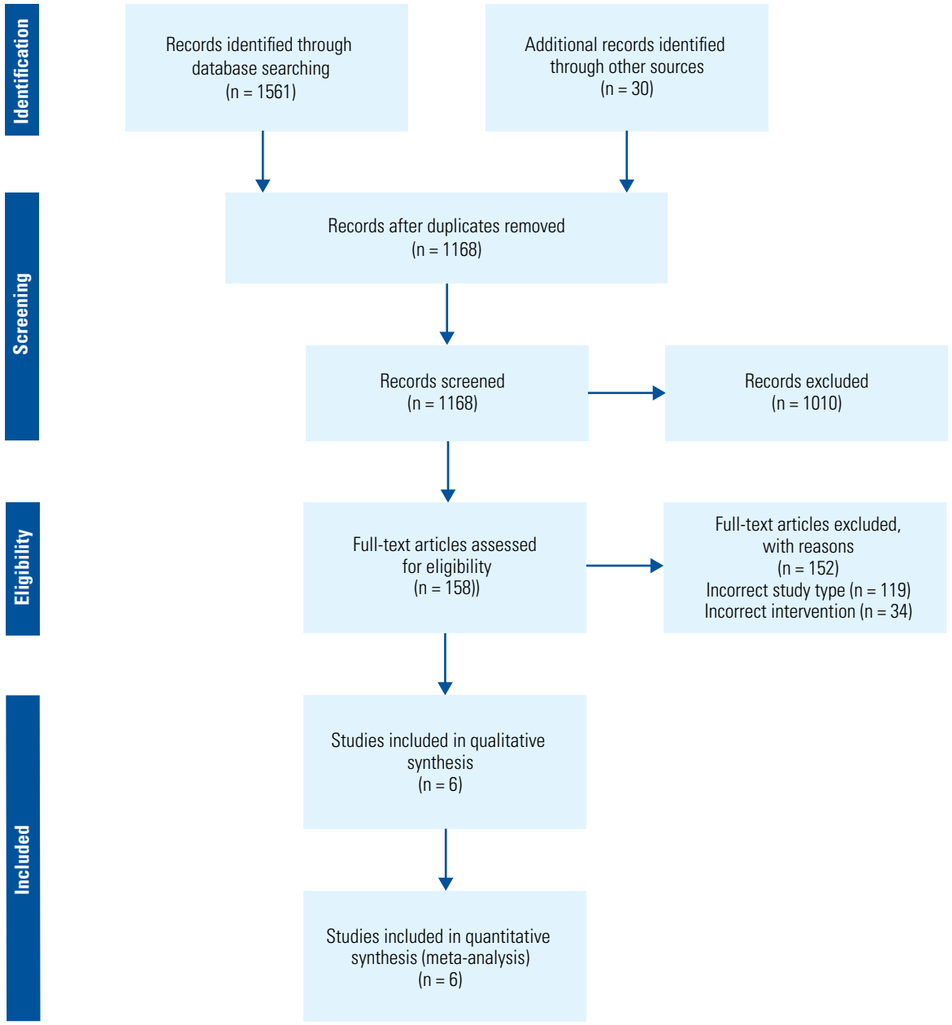
Study characteristics

The baseline characteristics and demographics of participants are included in **Table 1**.

Risk of bias assessment

Please refer to **Figures 2**, and **3**, as well as the study characteristics section. The completed Risk of Bias tool can be found in **Online Appendix 1**.

FIGURE 1.
Study flow diagram



Allocation

Random sequence generation

Four studies did not report the method of randomization used. One study (Garg 2014[14]) reported an adequate randomization method. Another study (Ravish 2007[15]) reported using alternative allocation, putting it at a high risk of bias.

Allocation concealment

Five studies were rated as unclear risk of bias because of insufficient information. The study by Ravish et al. was rated at a high risk of selection bias because of a poor randomization technique.

Blinding

Blinding of participants and personnel

We judged all 6 studies at high risk of bias due to the nature of the intervention.

Blinding of outcome assessment

Objective outcomes were assessed as being low risk of bias, while subjective outcomes were assessed as high

FIGURE 2.
Risk of bias graph: review authors' judgments about each risk of bias item presented as percentage across all included studies.

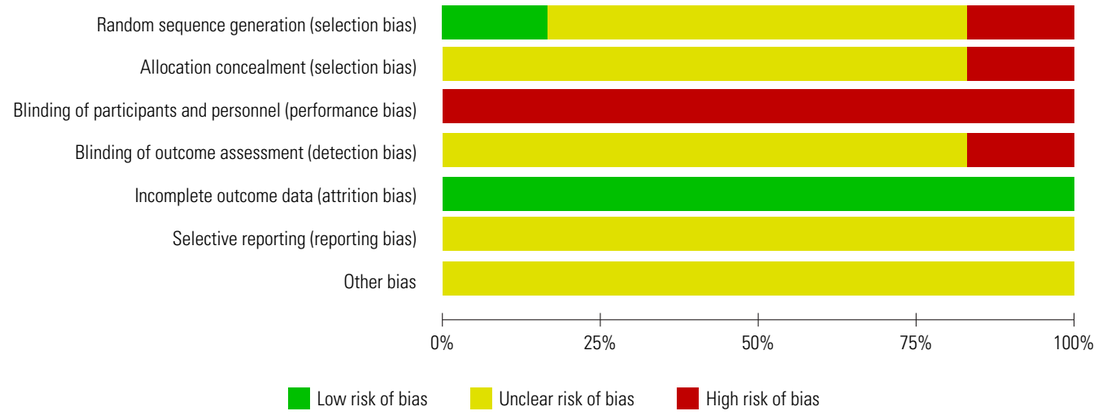
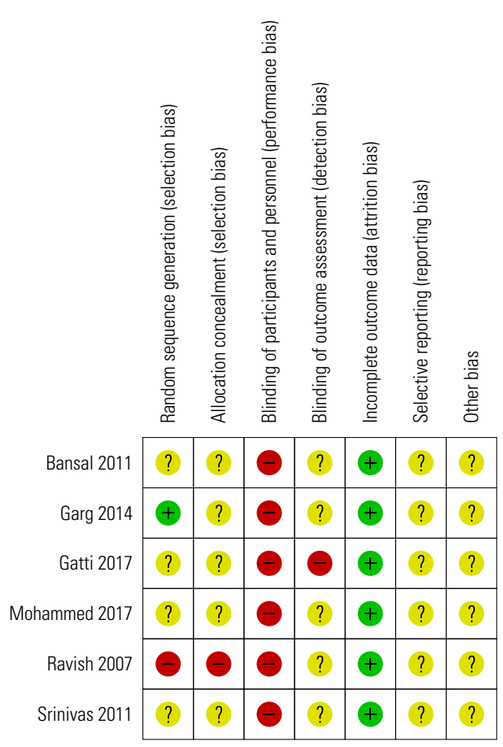


FIGURE 3.
Risk of bias summary: review authors' judgments about each risk of bias item for each included study.



risk of bias in 5 studies, resulting in overall high risk. In one study (Gatti 2017[16]), the operating surgeon completed all follow-up, leading to high risk of bias.

Incomplete outcome data

No studies reported incomplete data, indicating low risk of bias for all 6 studies.

Selective reporting

No studies included a published protocol. All outcomes appeared to be reported appropriately and logically as RCTs. Given that there was no protocol to compare, all 6 studies were judged as unclear risk of bias.

Other potential bias

No studies included any disclaimer or declaration regarding conflicts of interest or funding.

Publication bias

No publication bias was observed. A funnel plot was not feasible due to the low number of included studies.

Results of synthesis

Primary outcome—failure rate

All 6 studies included data on the failure rate of pyeloplasty (total, 304: LP, 148; OP, 156) (**Figure 4**). However, there were no events in Srinivas[17], making the risk ratio not estimable. In the adult population, LP likely results in no greater risk for failure compared to OP (RR, 1.23; 95% CI 0.32 to 4.72). There was no statical heterogeneity (I2=0%) among the included studies. Similar results were seen in the paediatric population (RR, 1.44; 95% CI 0.25 to 8.24).

Secondary outcomes

Operative time: Five studies included data on operative time (total, 304: LP, 148; OP, 156) (**Figure 5**). In adults,

TABLE 1.

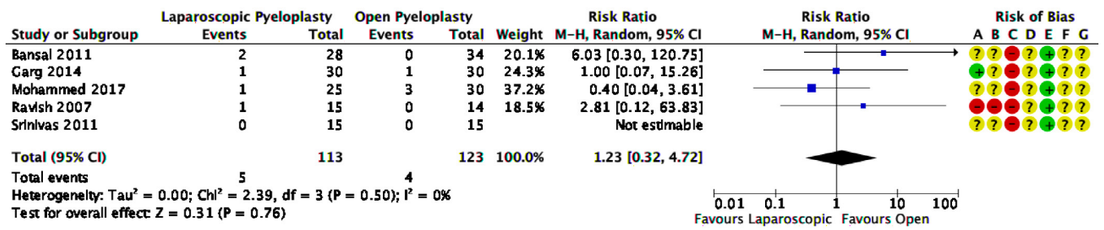
Baseline characteristics

Study Name	Bansal et al.[21]		Garg et al.[14]		Gatti et al.[16]		Mohammed et al.[22]		Ravish et al.[15]		Srinivas et al.[17]	
	LP	OP	LP	OP	LP	OP	LP	OP	LP	OP	LP	OP
Age (median in years)	31.64	29.58	27.27	23.47	6.8	7.6	NR	NR	31.64	29.58	20.42	22.83
Left Sided %	42.90%	47.10%	70%	56.70%	66%	69%	NR	NR	42.90%	47.10%	53.33%	46.60%
Gender (male %)	60.70%	58.80%	50%	56.70%	NR	NR	NR	NR	60.70%	58.80%	73.30%	73.30%
BMI (Kg/m^2) ± SD	NR	NR	NR	NR	NR	NR	28.4 ± 3.25	30.4 ± 3.5	NR	NR	NR	NR
Sample size	62		60		98		55		29		30	
Intervention (number)	Laparoscopic pyeloplasty (n = 28)		Laparoscopic pyeloplasty (n = 30)		Laparoscopic pyeloplasty (n = 50)		Laparoscopic pyeloplasty (n = 25)		Laparoscopic pyeloplasty (n = 28)		Laparoscopic pyeloplasty (n = 15)	
Control (number)	Open pyeloplasty (n = 34)		Open pyeloplasty (n = 30)		Open pyeloplasty (n = 48)		Open pyeloplasty (n = 30)		Open pyeloplasty (n = 34)		Open pyeloplasty (n = 15)	
Follow-up	33–34 months		3 months		16 weeks		12 months		3 months		3 months	
Study design	Prospective RCT		Prospective RCT		Prospective RCT		Prospective RCT		Prospective RCT		Prospective RCT	
Protocol	No		No		No		No		No		No	
Country/context	India/single centre		India/single centre		USA/not reported		Germany/not reported		India/single centre		India/single centre	
Language	English		English		English		English		English		English	
Dates of study	2004–2007		August 2011 – July 2013		2005–2014		August 2010 – August 2014		2004-2007		April 2004 – March 2005	
Inclusion criteria of participants	Symptomatic OR worsening renal function, radiographic evidence of PUJO		Diagnosis of PUJO		PUJO, under 18 years of age Indications for surgery		Overweight/obese (BMI > 25 kg/m^2) PUJO		Symptomatic OR worsening renal function radiographic evidence of PUJO		Primary PUJO including symptomatic and asymptomatic patients	
Exclusion criteria of participants	No information reported		<18 years of age Renal function <15% Coagulopathy Spinal deformity Cardiopulmonary compromise Refusal of randomization		Previous pyeloplasty		No information reported		No information reported		Secondary PUJO Urinary tract infection Redo pyeloplasty's Contraindications to surgery or laparoscopic surgery Long segment PUJO	
Demographics (LP vs OP)	Median age in years – 31.64 vs 29.58 Male sex (%) – 60.7% vs 58.8% left-sided operation (%) – 42.9% vs 47.1%		Median age in years – 27.27 vs 23.47 Male sex (%) – 50% vs 56.7% Left-sided operation (%) – 70% vs 56.7%		Median age in years – 6.8 vs 7.6 Male sex (%) – no information Left-sided operation (%) – 66% vs 69% Mean hydronephrosis grade – 3.5 vs 3.5		Mean BMI (kg/m^2) 28.4 ± 3.25 vs 30.4 ± 3.5		Median age in years - 31.64 vs 29.58 Male sex (%) – 60.7% vs 58.8% Left-sided operation (%) – 42.9% vs 47.1%		Median age in years – 20.42 vs 22.83 Male sex (%) – 73.3% vs 73.3% Left-sided operation (%) – 53.33% vs 46.6%	
Experimental intervention	Laparoscopic pyeloplasty (n = 28)		Laparoscopic pyeloplasty (n = 30)		Laparoscopic pyeloplasty (n = 50)		Laparoscopic pyeloplasty (n = 25)		Laparoscopic pyeloplasty (n = 28)		Laparoscopic pyeloplasty (n = 15)	
Control intervention	Open pyeloplasty (n = 34)		Open pyeloplasty (n = 30)		Open pyeloplasty (n = 48)		Open pyeloplasty (n =30)		Open pyeloplasty (n = 34)		Open pyeloplasty (n = 15)	
Primary outcome	Success of procedure		Success of procedure		Success of procedure		Success of procedure		Success of procedure		Postoperative pain score	
Definition of successful pyeloplasty	No recurrence of PUJO or conversion to OP intraoperatively		Recurrence of PUJO postoperatively		No information		Recurrence of PUJO on MAG 3 scan at 3 months		Recurrence of PUJO on follow up imaging		No information	
Secondary outcome	Operation time Analgesic requirement Length of hospital stay		Operation time Analgesic requirement Length of hospital stay Estimated blood loss Mean Hb drop postoperatively Success rate Day of drain removal post operatively		Cost analysis Length of operation Length of stay Analgesic use		Operation time Analgesic requirement Length of hospital stay Haemoglobin loss		Operation time Analgesic requirement Length of hospital stay		Postoperative functionality score	
Funding	No information		No information No information		No information		No information		No information		No information	
Declaration of conflict of interests	No information		No information		No information		No information		No information		No information	

LP: laparoscopic pyeloplasty, OP: open pyeloplasty.

FIGURE 4.

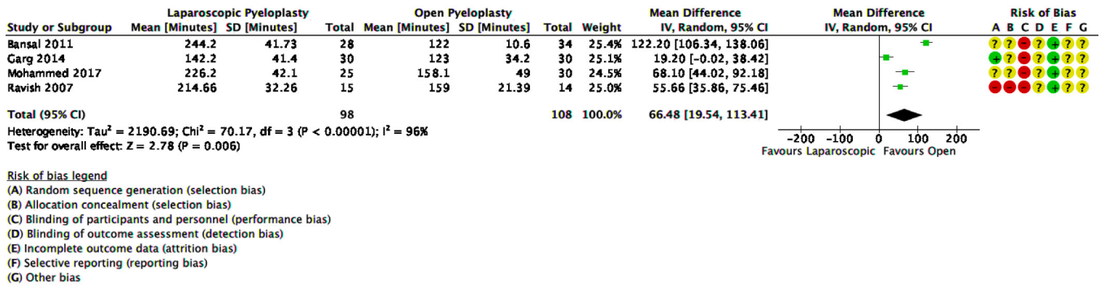
Forest plot for failure rate in laparoscopic versus open pyeloplasty



Risk of bias legend
(A) Random sequence generation (selection bias)
(B) Allocation concealment (selection bias)
(C) Blinding of participants and personnel (performance bias)
(D) Blinding of outcome assessment (detection bias)
(E) Incomplete outcome data (attrition bias)
(F) Selective reporting (reporting bias)
(G) Other bias

FIGURE 5.

Forest plot for operative time (minutes)



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(G) Other bias

LP likely results in a longer operative time of 66 minutes compared to OP (MD, 66.48 minutes; 95% CI 19.54 to 113.41). There is significant statistical heterogeneity (I2=96%). There was a smaller difference in the paediatric population of 17 minutes (MD, 17.00; 95% CI 3.04 to 30.96).

Length of stay: Five studies included data on length of stay (total, 304: LP, 148; OP, 156) (Figure 6). LP likely reduces hospital stay by 3 days in adults (MD, -3.55; 95% CI -1.52 to -5.58). There is substantial statistical heterogeneity (I2=92%). There was no difference in the paediatric group (MD, -0.10; 95% CI -4.58 to 4.37).

Complications: Four studies included data on complications (total, 269: LP, 123; OP, 126) (Figure 7). LP likely results in no difference in complication rates in adults (RR, 1.24; 95% CI 0.48 to 3.23). There is no significant statistical heterogeneity (I2= 0%). Similar results were seen in children (RR, 2.88; 95% CI 0.12 to 69.07).

Analgesia requirements: Two studies included data on this analgesia requirements (total, 122: LP, 58; OP, 64) (Figure 8). LP is likely to have a lower analgesia postoperative requirement (MD, -364.66; 95% CI -776.90 to 47.58). There is significant statistical heterogeneity (I2=99%).

Blood loss: One study included data on blood loss (total, 60: LP, 30; OP, 30) (Figure 9). LP likely results in little to no difference in blood loss (in millilitres) (MD, 8.52 mL; 95% CI -2.49 to 19.53). There was no data on blood loss for the paediatric population.

Cosmetic outcome: No studies included data on cosmetic outcome.

No subgroup analysis or sensitivity analysis was performed.

Summary of findings is shown in Table 2.

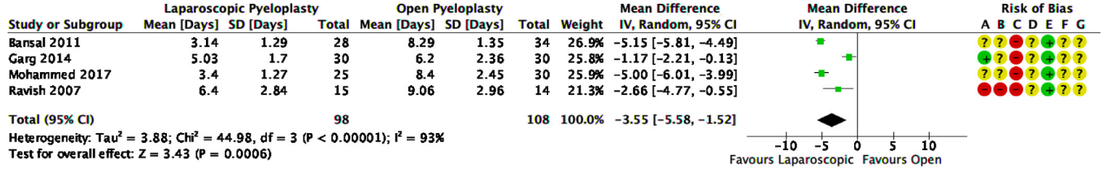
Discussion

Key findings

The review is based of 6 randomized controlled trials, all of which had relatively small sample sizes and events rates. Additionally, most studies had a relatively short follow-up period of 3 months, which limits the

FIGURE 6.

Forest plot for length of stay (days)



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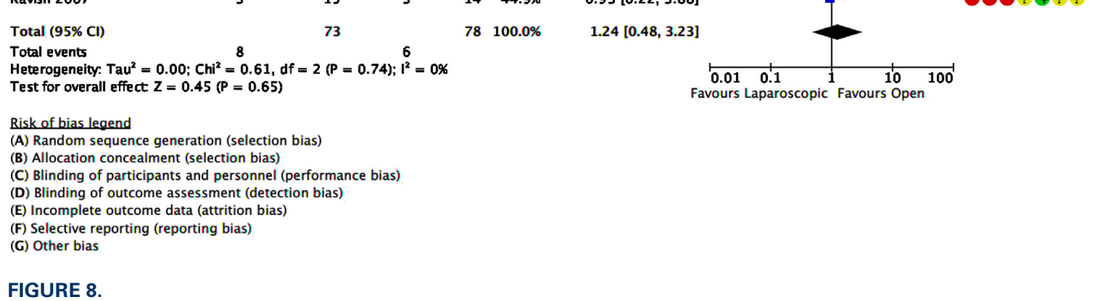
(G) Other bias

FIGURE 7.

Forest plot for complications



Risk of bias legend
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(C) Blinding of participants and personnel (performance bias)
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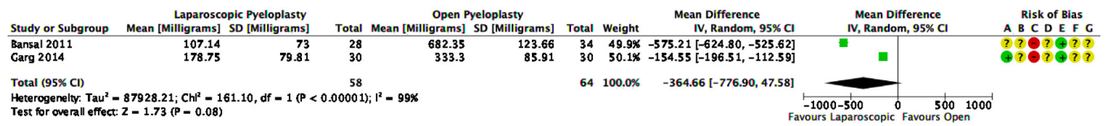
(F) Selective reporting (reporting bias)
(G) Other bias

FIGURE 8.

Forest plot for postoperative diclofenac use (mg)



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(G) Other bias

data to short-term outcomes. Long-term outcomes are important for choosing a surgical approach in all populations, however.

A key finding of this systematic review is the lack of high-quality studies endorsing the use of laparoscopic pyeloplasty over open pyeloplasty.

LP likely results in little to no difference in failure rate, complication rate, intraoperative blood loss, or short-term pain in both adult and paediatric populations. The laparoscopic approach likely has shorter hospital stays, decreased analgesic requirements, and improved pain at 7 days postoperatively. LP likely has longer operative times compared to OP.

The results of this systematic review highlight that the key clinical benefits of using a laparoscopic technique are a shorter length of stay and improved pain compared to OP. However, there is no significant difference in failure rates or complications between the 2 techniques. As such, patients can be counselled that LP may slightly

FIGURE 9.

Forest plot for blood loss (mL)

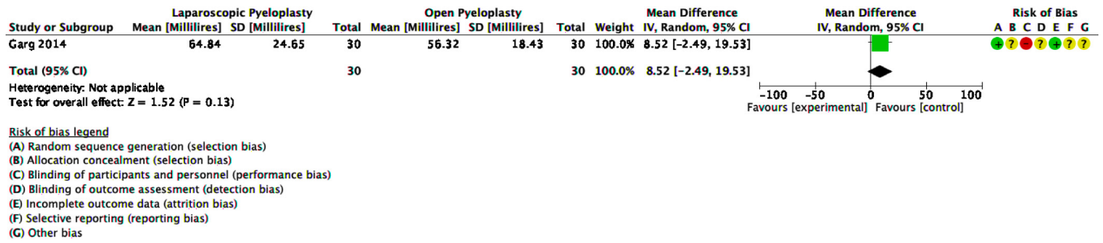

TABLE 2.

Summary of findings: Laparoscopic Pyeloplasty compared to Open Pyeloplasty for Pelvicoureteric Junction Obstruction

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	Nº of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with Open Pyeloplasty	Risk with Laparoscopic Pyeloplasty				
Failure Rate	38 per 1000	**50 per 1000** (17 to 146)	**RR 1.31 (0.45 to 3.79)**	304 (6 RCTs)	⊕⊕⊕◯ Moderate	
Operative Time		MD **56 Minutes more** (13.88 more to 98.91 more)	—	304 (5 RCTs)	⊕⊕⊕◯ Moderate	
Length of Stay		MD **3.18 days fewer** (5.13 fewer to 1.24 fewer)	—	304 (5 RCTs)	⊕⊕⊕◯ Moderate	
Complications	48 per 1000	**63 per 1000** (25 to 159)	**RR 1.33** (0.53 to 3.33)	249 (4 RCTs)	⊕⊕⊕◯ Moderate	
Analgesia Requirement (Postoperative Diclofenac requirement)		MD **364.66 mg lower** (776.9 lower to 47.58 higher)	—	122 (2 RCTs)	⊕⊕◯◯ Low	
Blood Loss		MD **8.52 mLs higher** (2.49 lower to 19.53 higher)	—	60 (1 RCT)	⊕⊕◯◯ Low	

***The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI). **CI:** confidence interval; **MD:** mean difference; **RR:** risk ratio*

GRADE Working Group grades of evidence
***High certainty:** we are very confident that the true effect lies close to that of the estimate of the effect.*

***Moderate certainty:** we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.*

***Low certainty:** our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect.*

***Very low certainty:** we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.*

improve recovery times and postoperative pain, but there is no significant difference in outcomes of either failure rates or complications. LP and OP are equivalent in these outcomes in both populations.

Comparison with existing knowledge

Previous systematic reviews comparing laparoscopic to open pyeloplasty have included only retrospective studies[12], focused on specific populations such as children[10], or compared other approaches such as robotic-assisted or retroperitoneal approaches[9,11]. Mei et al. had similar results in the paediatric population, with LP having shorted hospital stays without an increased risk for complications or failure of the pyeloplasty[10]. Huang et al. reported a shorter hospital stay and lower complication rate with LP compared to OP in children[18].

Strengths and limitations

This review employed a broad search strategy of numerous data sources to search for RCTs regardless of publication status and language. Despite this, there is a possibility of missing published studies in a language other than English, studies published in non-indexed journals, or studies not yet published.

This study only included randomized controlled trials, the gold-standard study type for an intervention such as LP compared to OP.

The quality of evidence was consistently downgraded for all studies included in this review due to the studies' intrinsic limitations. Given the surgical nature of the intervention, these studies are prone to selection bias from poor allocation concealment and lack of blinding[19]. Overall, all studies included in this review are at high risk of bias, and the results should be interpreted with caution.

An ongoing challenge in assessing new or evolving surgical techniques is accounting for user experience and the surgical learning curve[20]. Surgical outcomes are dependent on the experience of the surgeon, the number of procedures performed, and the centre's experience. Other specific factors that may affect outcomes for pyeloplasty include stent and drain placement, which were not assessed. Thus, this review cannot account for any of these factors, which may influence outcomes.

Implication for practice

This systematic review highlights the minor benefits offered by laparoscopic pyeloplasty. In practice, these minor benefits are unlikely to outweigh the surgeon's preference of approach based on their training, experience, and available resources. However, it emphasizes the importance of urologists in training to learn the laparoscopic approach for pyeloplasty.

Implication for research

Overall, this review has shown that LP may have some minor advantages over OP, but the evidence is of low quality. Further research could focus on larger sample sizes, with longer-term follow-up of participants. With the introduction of robotically assisted pyeloplasty, this approach could also be investigated with large RCTs.

References

1. Morris RK, Kilby MD. Congenital urinary tract obstruction. *Best Pract Res Clin Obstet Gynaecol.*2008;22(1):97–122. doi: 10.1016/j.bpobgyn.2007.08.007. PMID: 17904905.
2. Woodward M, Frank D. Postnatal management of antenatal hydronephrosis. *BJU Int.*2002; 89(2):149–156. doi: 10.1046/j.1464-4096.2001.woodward.2578.x. PMID: 11849184.
3. González R, Schimke CM. Ureteropelvic junction obstruction in infants and children. *Pediatr Clin North Am.*2001;48(6):1505–1518. doi: 10.1016/s0031-3955(05)70388-6. PMID: 11732127.
4. Chertin B, Pollack A, Koulikov D, Rabinowitz R, Hain D, Hadas-Halpren I, et al. Conservative treatment of ureteropelvic junction obstruction in children with antenatal diagnosis of hydronephrosis: lessons learned after 16 years of follow-up. *Eur Urol.*2006;49(4):734–738. doi: 10.1016/j.eururo.2006.01.046. PMID: 16504374.
5. Anderson JC; Hynes W. Retrocaval ureter; a case diagnosed pre-operatively and treated successfully by a plastic operation. *Br J Urol.*1949;21(3):209–214. doi: 10.1111/j.1464-410x.1949.tb10773.x. PMID: 18148283.
6. Carr BM, Lyon JA, Romeiser J, Talamini M, Shroyer ALW. Laparoscopic versus open surgery: a systematic review evaluating Cochrane systematic reviews. *Surg Endosc.*2019;33(6):1693–1709. doi: 10.1007/s00464-018-6532-2. PMID: 30357523.
7. Mandal A, Robertson S. Laparoscopic surgery advantages. In: *News Medical Life Sciences.*2019.
8. Sukumar S, Sun M, Karakiewicz PI, Friedman AA, Chun FK, Sammon J, et al. National trends and disparities in the use of minimally invasive adult pyeloplasty. *J Urol.*2012;188(3):913–918. doi: 10.1016/j.juro.2012.05.013. PMID: 22819404.
9. Ji F, Chen L, Wu C, Li J, Hang Y, Yan B. Meta-analysis of the efficacy of laparoscopic pyeloplasty for ureteropelvic junction obstruction via retroperitoneal and transperitoneal approaches. *Front Pediatr.*2021;9:707266. doi: 10.3389/fped.2021.707266. PMID: 34395345; PMCID: PMC8357990.
10. Mei H, Pu J, Yang C, Zhang H, Zheng L, Tong Q. Laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in children: a systematic review and meta-analysis. *J Endourol.*2011;25(5):727–736. doi: 10.1089/end.2010.0544. PMID: 21476861.

11. Chandrasekharam VVS, Babu R. A systematic review and meta-analysis of conventional laparoscopic versus robot-assisted laparoscopic pyeloplasty in infants. *J Pediatr Urol.*2021;17(4):502–510. doi: 10.1016/j.jpurol.2021.03.009. PMID: 33812779.

12. Uhlig A, Uhlig J, Trojan L, Hinterthaner M, von Hammerstein-Equord A, Strauss A. Surgical approaches for treatment of ureteropelvic junction obstruction - a systematic review and network meta-analysis. *BMC Urol.*2019;19(1):112. doi: 10.1186/s12894-019-0544-7. PMID: 31711468; PMCID: PMC6849262.

13. Sterne JAC, Savović J, Page MJ, Elbers RG, Blencowe NS, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ.*2019;366:l4898. doi: 10.1136/bmj.l4898. PMID: 31462531.

14. Garg M, Singh V, Sinha RJ, Sankhwar SN. Prospective randomized comparison of retroperitoneoscopic vs open pyeloplasty with minimal incision: subjective and objective assessment in adults. *Urology.*2014;83(4):805–811. doi: 10.1016/j.urology.2013.11.024. PMID: 24485998.

15. Ravish IR, Nerli RB, Reddy MN, Amarkhed SS. Laparoscopic pyeloplasty compared with open pyeloplasty in children. *J Endourol.*2007 Aug;21(8):897-902. doi: 10.1089/end.2006.0411. PMID: 17867949 Clinical Trial.

16. Gatti JM, Amstutz SP, Bowlin PR, Stephany HA, Murphy JP. Laparoscopic vs open pyeloplasty in children: results of a randomized, prospective, controlled trial. *J Urol.*2017 Mar;197(3 Pt 1):792-797. doi: 10.1016/j.juro.2016.10.056. Epub 2016 Oct 17.

17. Srinivas KK, Uppin IV, Nerle RB. A prospective randomized controlled trial complains open pyeloplasty and laparoscopic pyeloplasty for ureteropelvic junction obstruction (UPJO): subjective outcome. *J Clin Diagn Res.*2011;5(8):1601–1605.

18. Huang Y, Wu Y, Shan W, Zeng L, Huang L. An updated meta-analysis of laparoscopic versus open pyeloplasty for ureteropelvic junction obstruction in children. *Int J Clin Exp Med.*2015;8(4):4922–4931. PMID: 26131065; PMCID: PMC4483847.

19. McCulloch P, Taylor I, Sasako M, Lovett B, Griffin D. Randomised trials in surgery: problems and possible solutions. *BMJ.*2002;324(7351):1448–1451. doi: 10.1136/bmj.324.7351.1448. PMID: 12065273; PMCID: PMC1123389.

20. Dahm P. Envisioning an IDEAL future for urological innovation. *BJU Int.*2016;117(3):387–388. doi: 10.1111/bju.13129. PMID: 25810303.

21. Bansal P, Gupta A, Mongha R, Narayan S, Das RK, Bera M, Chakraborty SC, Kundu AK. Laparoscopic versus open pyeloplasty: comparison of two surgical approaches- a single centre experience of three years. Indian J Surg. 2011 Aug;73(4):264-7. doi: 10.1007/s12262-011-0237-2. Epub 2011 Apr 26. PMID: 22851839; PMCID: PMC3144340.

22. Mohamed HE, EL-Asmar KM, Hassan TA , ELShafei EA, Soliman MH, Allam AM. Feasibility, safety and effectiveness of laparoscopic transperitoneal pyeloplasty in children: Ain Shams University early experience. *Ann Pediatr Surg.*2022;18(26). https://doi.org/10.1186/s43159-022-00164-5