

# Redo laparoscopic pyeloplasty among children: A systematic review and meta-analysis

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## Abstract

Laparoscopic pyeloplasty (LP) is more beneficial than open procedures. However, studies on laparoscopic management of cases with secondary ureteropelvic junction obstruction (SUPJO) after previous failed pyeloplasty in the pediatric population are lacking. This meta-analysis aimed to assess the difference between redo LP (RLP) and redo open pyeloplasty (ROP) for children with SUPJO, focusing on certain criteria. All recent studies on RLP and ROP in children with SUPJO were searched. Search engines such as Medline, PubMed, and The Cochrane Library of Systematic Reviews were used. Sixty citations were specified. Two reviewers extracted data independently, screened the titles, and assessed the quality of each citation. Continuous data reported as a weighted mean difference (WMD) (95% confidence interval) and dichotomous data reported as relative risk were used. We measured the length of hospital stay (LOS) and operative time using weighted mean and success and complication rates using risk difference and odds ratio (OR). A random effects model was used to pool OR that was tested for heterogeneity. We specified six publications that minutely met our eligibility standards. Meta-analysis of given data resulted in the following: ROP showed reduction in operative time by 12 min (WMD: 12.7 min;  $P = 0.14$ ). RLP had shorter LOS than ROP (WMD: 0.6 days;  $P < 0.01$ ). No difference was observed in complication and success rates (OR: 0.8;  $P = 0.50$  and OR: 1.2;  $P = 0.51$ , respectively). In conclusion, RLP seems to be better than ROP in terms of LOS reduction; however, both are comparable with respect to success and complication rates, especially postoperative urine leakage.

**Keywords:** Complication, failed pyeloplasty, laparoscopy, outcome, ureteropelvic junction obstruction

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## INTRODUCTION

Secondary ureteropelvic junction obstruction (SUPJO) can be treated safely and successfully by laparoscopic pyeloplasty (LP) in all age groups.<sup>[1]</sup> Open Pyeloplasty (OP) in many institutes was the gold standard till the emergence of laparoscopic approach.<sup>[2]</sup> Advantages of laparoscopy

include short length of hospital stay (LOS), less pain, fast recovery, and better cosmetic appearance. However, it is only performed in experienced centers with high patient flow.<sup>[3]</sup> LP has improved some complications and overcome limitations of OP.<sup>[4,5]</sup> Several studies proved the superiority of laparoscopy versus the open approach.<sup>[6]</sup> However, studies comparing laparoscopy and OP in the field of pyeloplasty,

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especially in children with SUPJO, are very limited. Some studies showed that LP has the superiority, while other studies showed no extra benefits.<sup>[7,8]</sup> There are limited data that substantially uphold one type over the other. This meta-analysis study aimed to assess the feasibility and effectiveness of redo LP (RLP) versus that of redo open pyeloplasty (ROP) in children with SUPJO, in terms of operative time, LOS, success rate, and postoperative complications (urine leakage) and to evaluate the quality of proof in the literature and provide accurate clinical information.

## METHODS

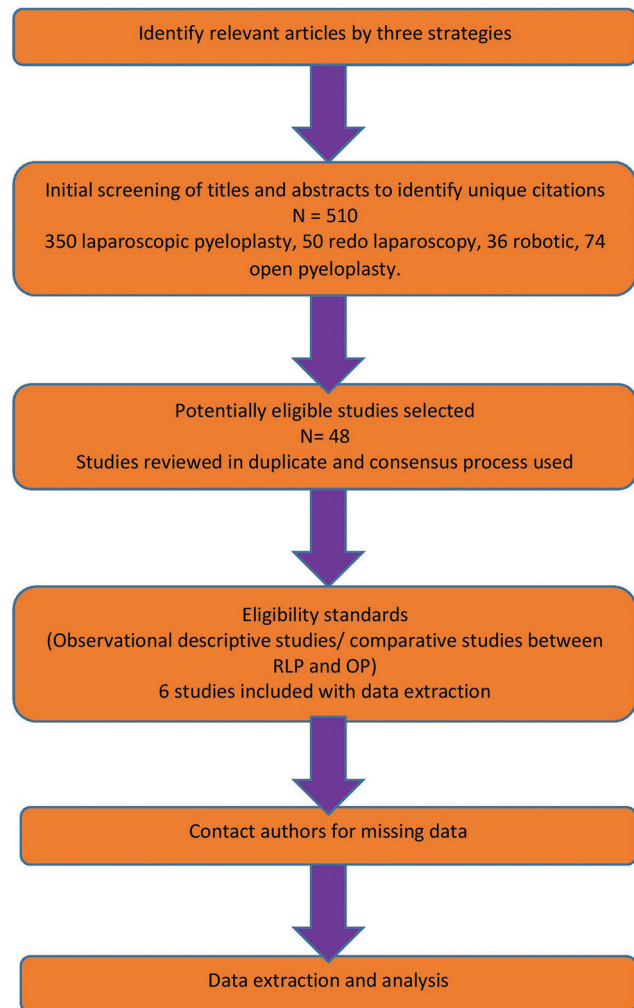
We used three ways to identify relevant studies: (1) search in electronic database, (2) experts' opinion, and (3) article reviews from those that accomplished our eligibility standards. The following search engines were used in this study: Medline, PubMed, and The Cochrane Library of Systematic Reviews. All chosen articles were then filtered according to the Medical Subject Heading terms to retrieve information that may use different terminologies for the same concepts and to find articles indexed more narrowly. All possible combinations were considered. The study design has been approved by our institutional review board.

A search regimen for every database was designed and executed by a librarian; all search terms and eligible citations were tested. Latin American and Caribbean Health Sciences Literature, Scientific Electronic Library Online, and Excerpta Medica Database were all included in our search. Sixty citations were identified. Two researchers checked the abstracts and titles independently and chose the most relevant articles for in-depth review using our selection standards that presuppose selection of any article comparing RLP with ROP in children with SUPJO.

After the process of selection and review, six studies were used<sup>[9-14]</sup> [Figure 1], with 97% approval among reviewers. Any disagreement was resolved by unanimity between reviewers. According to the absence of randomized controlled trials, all observational studies that met our selection and eligibility criteria were included.

Our selection criteria were confined to the pediatric population and comparisons between OP and LP for cases with failed primary open pyeloplasty. Two references were excluded from the analysis<sup>[1,2]</sup> due to (1) mean patient age of 35.0 (range 9–77) years and 29.8 (range 5–65) years and (2) the number of shared children not being mentioned.

The main issue assessed was success rates. In addition, the focus was on study designs and methodologies,



**Figure 1:** Search process for the systemic review and meta-analysis

concentrating on demographics, sample size and sampling methods, and techniques of pyeloplasty. We tried to overcome any potential confounders in the analysis such as matching of surgeon experience as far as possible [Table 1].

The Newcastle–Ottawa Scale was employed for assessing the quality of nonrandomized studies in meta-analyses.<sup>[15]</sup> The quality of methodology was categorized as high (score 5–7) and low methodological quality (score <5). Applicability, comparability, and selection of groups as well as outcome evaluation and follow-up adequacy were all independently assessed and scored by two specialists [Table 2]. The percentage of consensus and agreement among reviewers was almost 97%.

The success after the procedure was measured by the absence of obstruction in the radiological investigations during follow-up. Moreover, success could be defined as disappearance of symptoms, amelioration of hydronephrosis on ultrasound, improvement of the renal

**Table 1: Characteristics of included studies**

Study, year	Design	Matching	Single surgeon	Mean age, (RLP/OP)	Number of patients (RLP/OP)	Outcome measurements	Mean follow up months (RLP/OP)
Hammady <i>et al.</i> , 2017 <sup>[9]</sup>	Retrospective	Yes	Yes	23.6/17.4 months	24/24	Success rate, complication rate, operative time, hospital stay	35.5/35.5
Abdel-Karim <i>et al.</i> , 2016 <sup>[10]</sup>	Retrospective	No	Yes	13.2/11.8 years	24/15	Success rate, complication rate, operative time, hospital stay	18/18
Piaggio <i>et al.</i> , 2007 <sup>[11]</sup>	Retrospective	No	Yes	90/160 months	6/5	Success rate, complication rate, operative time, hospital stay	24/34
Moscardi <i>et al.</i> , 2017 <sup>[12]</sup>	Retrospective	No	Yes	82/107 months	11/71	Success rate, complication rate, operative time, hospital stay	145/103
Abraham <i>et al.</i> , 2015 <sup>[13]</sup>	Retrospective	No	Yes	16/30 months	4/11	Success rate, complication rate, operative time, hospital stay	29/29
Romao <i>et al.</i> , 2013 <sup>[14]</sup>	Retrospective	No	Yes	24.9/19.3 months	19/27	Success rate, complication rate, operative time, hospital stay	27.4/27.4

RLP: Redo laparoscopic pyeloplasty, ROP: Redo open pyeloplasty

**Table 2: Modified Newcastle–Ottawa scale for assessment of methodological quality of studies**

Study, year	Selection	Comparability	Outcome	Score (max 7)
Hammaday <i>et al.</i> , 2017 <sup>[9]</sup>	1	2	1	4
Abdel-Karim <i>et al.</i> , 2016 <sup>[10]</sup>	1	1	1	3
Piaggio <i>et al.</i> , 2007 <sup>[11]</sup>	2	1	1	4
Moscardi <i>et al.</i> , 2017 <sup>[12]</sup>	2	2	1	5
Abraham <i>et al.</i> , 2015 <sup>[13]</sup>	2	2	1	5
Romao <i>et al.</i> , 2013 <sup>[14]</sup>	1	1	2	4

function with absence of obstruction on dynamic renal scintigraphy.

The experience in the field of laparoscopy was determined at different levels. The experience was classified as high when the author was recognized to be an expert or leader in his/her field and had many contributions on his/her topic (>5 *de novo* researches). Modest experience is described as an initial or premier practice and if the number of cases performed per year was <5 and/or the number of publications was <3. This may be somewhat totalitarian that the level of experience in laparoscopy was investigated using track records as a fiduciary.

Success and complication rates were measured by risk difference and odds ratio (OR). A random effects model was used to pool ORs that were tested for heterogeneity, using the Chi-square test. Funnel plots were used to ascertain any bias concerned with publication evidence. The analysis was performed using the Cochrane Initiative software (Review Manager [RevMan] v.5.0, 2008), London, United Kingdom.

## RESULTS

Six publications met our selection standards. All of them were full-text papers. None of our selected articles was a

review article; otherwise, it would have been subsequently excluded because it would not provide extra information.

### Study characteristics

Table 1 presents the study characteristics and methodology for the six observational studies included in the meta-analysis. Of these, none used a prospective design, but all of them used a retrospective design.<sup>[9-14]</sup> Of the six retrospective studies, two used prospectively collected data.<sup>[11,14]</sup> Two studies were from North America,<sup>[11,14]</sup> two from Egypt,<sup>[9,10]</sup> one from India,<sup>[13]</sup> and one from Brazil.<sup>[12]</sup> One publication reported matching numbers of patient groups for age and surgical procedure, and all of them were based on a single-surgeon experience. All publications reported on similar outcomes with regard to operative time, complications, LOS, and success rates. Information was available for all six studies apart of some minute data obtained by directly contacting the authors.

### Operative time

Of the six studies that assessed operative time, two showed similar operative time for RLP and ROP,<sup>[10,13]</sup> two indicated that OP time was shorter than RLP time<sup>[9,12]</sup> (with an insignificant difference in one study<sup>[12]</sup>), and two revealed that RLP operative time was insignificantly shorter than OP time.<sup>[11,14]</sup> The meta-analysis of six studies showed that ROP was associated with a 12-min reduction of operative time (random effects model; WMD: 12.7 min; 95% confidence interval [CI] 24.6–3;  $P = 0.14$ ). Results for heterogeneity and overall effect were as follows: test for heterogeneity:  $\chi^2 = 29.2$ ,  $df = 4$  ( $P < 0.0001$ ),  $I^2 = 88.4\%$ ; test for overall effect:  $Z = 0.66$  ( $P = 0.69$ ), as shown in Figure 2.

### Length of hospital stay

Of the six studies that analyzed the LOS, four reported that RLP was associated with a shorter hospital stay,<sup>[9,11,12,14]</sup> while two showed no difference between the two approaches.<sup>[10,13]</sup> The meta-analysis of extractable data

from all studies demonstrated a significantly shorter hospital stay after RLP than after ROP (random effects model; WMD: 0.6 days; 95% CI: 0.6–0.4;  $P < 0.01$ ), subtotal (95% CI), and WMD = -0.49 (-0.57, -0.41), test for heterogeneity:  $\chi^2 = 8.00$ ,  $df = 3$  ( $P < 0.01$ ),  $I^2 = 47.8\%$ , test for overall effect:  $Z = 18.36$  ( $P = 0.004$ ), as shown in Figure 3.

### Complication rate

Of the six studies that appraised complication rate, three had similar complication rates for both procedures.<sup>[11,13,14]</sup> Three showed slightly higher complication rates after ROP,<sup>[9,10,12]</sup> and no study reported more complications following RLP; all differences were statistically significant. The meta-analysis of these six studies showed that both procedures had similar complication rates (random effects model, OR: 0.8; 95% CI: 0.3–1.6;  $P = 0.50$ ), total events: 11 laparoscopic, 13 open pyeloplasty, test for heterogeneity:  $\chi^2 = 4.05$ ,  $df = 8$  ( $P < 0.91$ ),  $I^2 = 0\%$ , test for overall effect:  $Z = 0.76$  ( $P = 0.50$ ), as shown in Figure 4.

### Success rate

Of the six studies that evaluated this outcome, three revealed a 100% success rate for both approaches,<sup>[10,11,14]</sup> two showed higher success rates with RLP than with ROP (100% vs. 97% and 99% vs. 97%),<sup>[9,13]</sup> and one

had a better success rate with ROP than with RLP (100% vs. 97%).<sup>[12]</sup> The meta-analysis of these six studies demonstrated equivalent success rates for both procedures (random effects model, OR: 1.2; 95% CI: 0.5–3.5;  $P = 0.51$ ), total (95% CI): 1.09 (0.48, 3.14), total events: 88 laparoscopic, 153 open pyeloplasty, test for heterogeneity:  $\chi^2 = 2.25$ ,  $df = 7$  ( $P < 0.84$ ),  $I^2 = 0\%$ , test for overall effect:  $Z = 0.56$  ( $P = 0.79$ ), as shown in Figure 5.

### DISCUSSION

We compared RLP with ROP in our systematic review using six observational studies.<sup>[9-14]</sup> Patients were selected meticulously according to the quality standards in these studies. Measurement of outcome and follow-up appropriateness were also considered. RLP has no advantage over ROP regarding operative time, especially when a random effects model was used in our pooled tests. When we considered the heterogeneity among researches, the analysis became more conservative.

The operative time was quite short in ROP when compared with RLP among centers with unpretentious experience in LP.<sup>[9,12]</sup> This observation proposes that ROP may be beneficial to centers with low LP experience because it may lengthen the learning curve of LP.

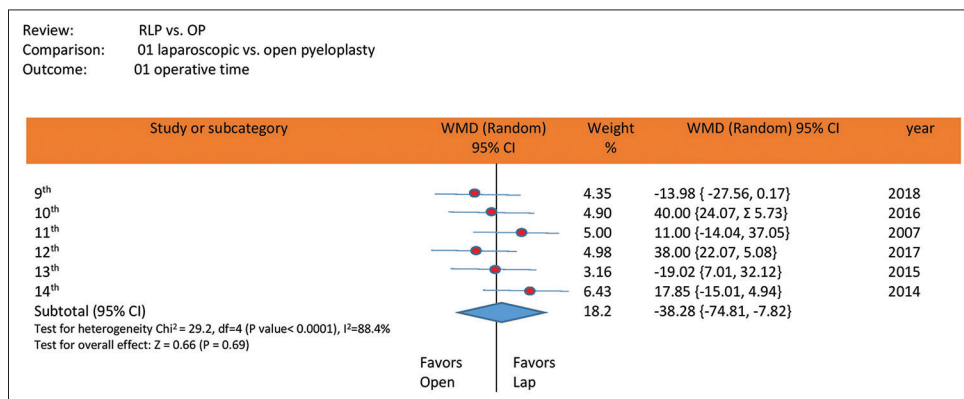


Figure 2: Pooled estimate of operative time using a random effects model. CI: confidence interval, WMD: weighted mean difference

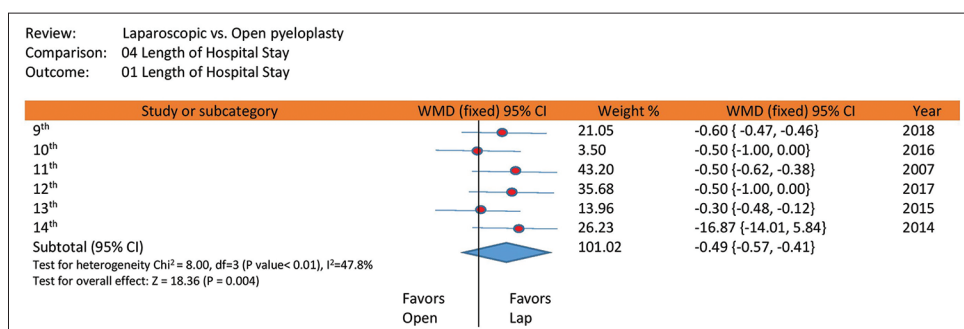


Figure 3: Pooled estimate length of hospital stay using a random effect model. CI: confidence interval, WMD: weighted mean difference

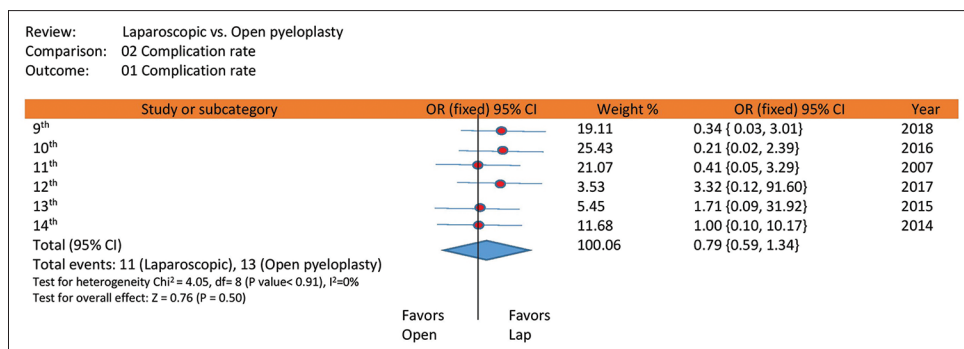


Figure 4: Pooled estimate of complication rate using a random effect model. CI: Confidence interval, WMD: Weighted mean difference

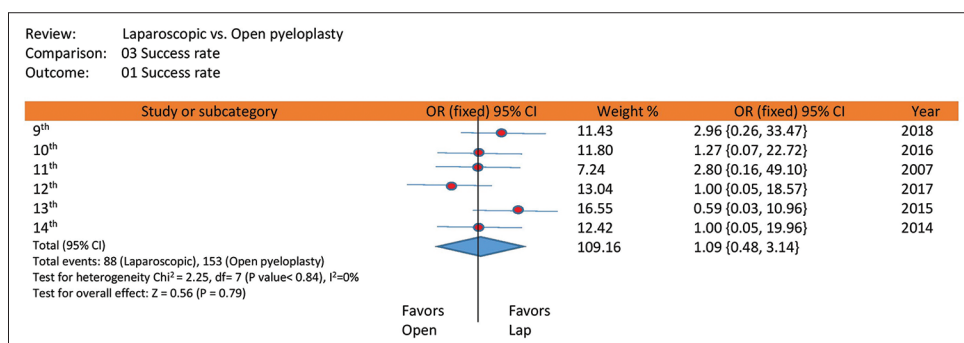


Figure 5: Pooled estimate of success rate using a random effect model. CI: Confidence interval, WMD: Weighted mean difference

However, we should interpret this estimate cautiously because meta-analysis of six studies shows that ROP was associated with only a 12-min reduction of operative time.

Laparoscopy is somewhat challenging among the pediatric population due to the lack of space and difficult hardware installment.<sup>[16]</sup> For this reason, RLP requires more operative time than ROP. We speculate that the ROP operative time was quite short due to relative low mean age of children in our studies. Such ages provide diminished space for articulation of the laparoscope.

In addition, the difference between experiences of surgeons might be a causative factor influencing the operative time. This difference may be due to smaller caseload and case volume among surgeons dealing with children.<sup>[17]</sup>

A significantly short LOS was observed using a random effects model for RLP when compared with that for ROP. Recent articles showed early patient discharge, and a trend was observed for this. This trend may be due to the modern tendency of hospitals to reduce charges and costs and minimize patient stay by any means.<sup>[18,19]</sup> Early discharge was not observed in a series of four studies.<sup>[9,12-14]</sup>

As a real effect on LOS, RLP may not have a true effect on LOS when compared with ROP due to the underlying

reason of the modern direction of hospitals that tends to minimize the length of hospital stay. The difference observed (0.6 days reduction) had a very restricted clinical rapport even if it was due to the type of procedure performed.

LP tries to imitate open pyeloplasty; however, experts refer to potential advantages with the laparoscope. The complication and success rates in both RLP and ROP appear to be equivalent, and this is not surprising. Therefore, it is necessary to mention that the follow-up duration was not too long to detect late failures.<sup>[20]</sup> Moreover, this was demonstrated in studies of ROP with long-term follow-up periods.<sup>[21]</sup> Several different methods are available to measure success for these minimally invasive procedures. Thus, it will be difficult, premature, and problematic to form a judgment to define success and success rates. Success could be assessed by pain relief and improvements in renal scan results and hydronephrosis. In our selected studies, stability or improvement in scintigraphy or ultrasound after pyeloplasty is considered as a way to measure success, due to poor reporting of outcomes.

To the best of our knowledge, this study is the first meta-analysis on RLP in the pediatric population. It is imperative to evaluate new modality outcomes

and compare them with conventional ones before implementation of this new technology on patients. Multiple designs were undertaken for identification of studies, including three ways to identify relevant studies. Therefore, we expect to have included most of the studies related to our topic.

The process of selection itself helped to reduce perplexity although our selected studies had small sample sizes. We matched age and surgical practicability and inclusion of single-surgeon experience.

This study has several limitations. Our level of evidence is low due to inability to identify randomized control trials. It is better to find a randomized control trial comparing two surgical techniques, but it is very rare due to intrinsic limitations related to blinding and randomization. Therefore, we address our question using observational studies as it is the strongest available and feasible option. In addition, all potential biases in selected studies were transferred to our report.

We tried our best to contact authors to access primary data; however, only published data were used in performance of this review. In addition, keeping in mind that all studies have their methodological limitations is important.<sup>[22]</sup> Nonetheless, we can still deduce useful information upon analysis of these observational studies as long as we eliminate any confounding factors.

By data explorations, we could easily recognize reasonable explanations for differences observed in results among selected studies, through meta-analysis and systemic reviews. In the absence of unexplained homogeneity, while the findings associated with the combined estimates are weaker, these estimates provide the best estimate of the mean effect and thus constitute beneficial information for surgeons facing the challenge of making a decision based on the restricted evidence available.

Cost issues are a very important point to be further discussed in the future because this may reveal decisive differences between both procedures. We did not discuss this issue because it is related to the surgeon and his/her daily practice decisions.

## CONCLUSIONS

RLP and ROP seem to be equipollent with regard to success rates and postoperative complication rates. The rating of the effect of treatment on operation time supplied by the random effects model does not support or recommend one

method over the other. However, RLP showed significantly shorter LOS than ROP.

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## Conflicts of interest

There are no conflicts of interest.

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