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Laparoscopic Extravesical versus Transvesicoscopic Ureteric Reimplantation for Paediatric Vesicoureteric Reflux: A 15-Year Retrospective Single-Centre Study

ABSTRACT
Background. *Minimally invasive ureteric reimplantation is an accepted alternative to open surgery for children with vesicoureteric reflux needing definitive correction. The main techniques are laparoscopic extravesical reimplantation and transvesicoscopic reimplantation, but single-centre comparative data are limited. We compared the peri-operative and clinical outcomes of the two methods.*
Methods. *A retrospective review was conducted on children who underwent minimally invasive ureteric reimplantation for primary vesicoureteric reflux at a tertiary centre in South India from 2010 to 2025. The urology service performed laparoscopic extravesical reimplantation, while the paediatric surgery service conducted transvesicoscopic reimplantation. We compared demographics, reflux grade and laterality, operative time, urethral catheter duration, hospital stay, reflux resolution, and complications.*
Results. *Of 106 children, 60 underwent laparoscopic extravesical reimplantation, and 46 underwent transvesicoscopic reimplantation. The groups were similar in age (4.8 [SD 2.1] v. 5.1 [SD 2.4] years), high-grade reflux (63% v. 65%), prior febrile urinary tract infection (80% v. 85%), and pre-existing renal scarring (26% v. 30%). Bilateral reflux was more common in the transvesicoscopic group (78.3% v. 13.3%; p<0.001). For unilateral cases, the extravesical approach had a shorter operative time (90 [SD 15] v. 110 [SD 18] minutes; p=0.01); in bilateral cases, the time difference was not significant (140 [SD 20] v. 150 [SD 22] minutes; p=0.18). Catheter duration was shorter after the extravesical procedure (1.2 v. 6.0 days; p<0.001), while the hospital stay was similar (2.1 v. 2.3 days; p=0.24). Complication rates (6.6% v. 10.8%; p=0.42) and re-operation rates (3.3% v. 2.1%; p=0.70) did not differ.*
Conclusions. *Both laparoscopic extravesical and transvesicoscopic ureteric reimplantation are safe and effective for paediatric vesicoureteric reflux. The extravesical approach offers advantages in unilateral cases with shorter operative time and quicker catheter removal, whereas the transvesicoscopic approach efficiently addresses bilateral reflux. The choice between methods should be guided by laterality and institutional expertise.*

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I. INTRODUCTION

Vesicoureteric reflux (VUR) affects about 1%–2% of children and is present in up to 30%–40% of those assessed after a febrile urinary tract infection (UTI). While low-grade disease often resolves spontaneously, a significant number of children with high-grade reflux, breakthrough febrile UTIs on antibiotic prophylaxis, or progressive renal scarring need surgical correction.[1,2] Open ureteric reimplantation remains the standard with success rates exceeding 95%, but it involves the morbidity of a lower abdominal incision, extended catheterisation, and bladder spasms.[3]

Over the last twenty years, two minimally invasive alternatives have been widely adopted. Laparoscopic extravesical ureteric reimplantation (LEVUR) replicates the Lich-Gregoir detrusorrhaphy, approaching the ureterovesical junction transperitoneally without opening the bladder mucosa.[4,5] Transvesicoscopic ureteric reimplantation (TVUR), initially described by Yeung et al., uses carbon dioxide pneumovesicum for an intravesical Cohen cross-trigonal reimplantation.[6,7] Each technique has theoretical benefits: LEVUR avoids cystotomy and allows early catheter removal, while TVUR maintains familiar intravesical anatomy and enables addressing both ureters within the same working space.

In many Indian centres, these methods have evolved along parallel lines, with LEVUR preferred by urologists and TVUR by paediatric surgeons, and single-centre direct comparisons are limited. We evaluated our 15-year experience to compare the peri-operative course, safety, and efficacy of LEVUR and TVUR in children with VUR and to identify the clinical settings in which each approach is most suitable.

II. METHODS

Study Design and Setting

This retrospective comparative cohort study was conducted at a tertiary referral teaching hospital in South India. The study received approval from the Institutional Ethics Committee, which waived the need for individual informed consent due to the retrospective nature of the study. The study was conducted in accordance with the Declaration of Helsinki and is reported according to the STROBE guidelines for observational studies.

Selection of Participants

Records of all children (under 18 years) who underwent minimally invasive ureteric reimplantation for primary VUR between January 2010 and [month] 2025 were reviewed. LEVUR was performed by the urology service and TVUR by the paediatric surgery service, reflecting departmental practice rather than formal allocation. Children with secondary VUR (e.g., posterior urethral valves, neurogenic bladder), prior ureteric surgery, or incomplete records were excluded.

Surgery was indicated uniformly across services: breakthrough febrile UTI despite continuous antibiotic prophylaxis, high-grade (grade IV–V) reflux persisting beyond the expected resolution age, new or progressive renal scarring on dimercaptosuccinic acid (DMSA) scintigraphy, and parental preference for definitive treatment. Pre-operative evaluation included ultrasonography, voiding cystourethrography (VCUG) graded by the International Reflux Study classification, and a DMSA scan.

Surgical Technique: Laparoscopic Extravesical Reimplantation

Under general anaesthesia with a urethral catheter in place, a three-port transperitoneal approach was used. The ureter was located at the pelvic brim or near the vas deferens or round ligament and mobilised to the ureterovesical junction, preserving its adventitial vasculature and the pelvic plexus. With the bladder partially distended, a detrusorotomy approximately five times the ureter's diameter was created cephalad from the hiatus, exposing the mucosa without breaching it. The ureter was positioned in the trough, and the detrusor edges were closed over it with interrupted absorbable sutures, followed by re-peritonealisation. The urethral catheter was removed on the first post-operative day.

Surgical Technique: Transvesicoscopic Reimplantation

Following cystoscopic assessment, the bladder was insufflated with carbon dioxide to 10–12 mmHg. A 5-mm camera port and two 3- or 5-mm working ports were placed suprapubically. Each ureteric orifice was intubated, circumscribed, and mobilised intravesically for 2–3 cm. A cross-trigonal submucosal tunnel was created, and the ureter was drawn across and anastomosed to the contralateral mucosa with interrupted absorbable sutures, as described by Cohen. Port sites were closed, and a urethral catheter was retained for the duration specified in the Results.

Outcome Measures

The primary outcome was the resolution of reflux, defined as the absence of reflux on VCUG performed [3–6] months post-surgery with no febrile UTI during follow-up. Secondary outcomes included operative time (skin incision to closure, inclusive of both sides in bilateral cases), urethral catheter duration, hospital stay length, intra- and post-operative complications graded by the Clavien–Dindo classification, and re-operation for persistent reflux or obstruction. [State number lost to follow-up, if any.]

Statistical Analysis

Continuous variables are expressed as the mean (standard deviation, SD) and were compared using Student's t-test. Categorical variables are presented as numbers (percentages) and compared using the chi-square test or Fisher's exact test as appropriate. Exact two-sided p values are reported, and $p<0.05$ was considered statistically significant. Analyses were performed using [software name, version].

III. RESULTS

A total of 106 children were included: 60 underwent LEVUR and 46 underwent TVUR. Baseline characteristics were similar (Table I). Approximately two-thirds of children in each group had high-grade reflux, four-fifths had at least one febrile UTI, and just over a quarter had pre-existing renal scarring on DMSA.

The primary difference between the cohorts was laterality. Unilateral reflux was predominant in the LEVUR group (52 of 60, 86.7%), while bilateral reflux was more common in the TVUR group (36 of 46, 78.3%; $p<0.001$), consistent with the differing case selection of the two services (Table II).

For unilateral cases, LEVUR was significantly faster than TVUR ($p=0.01$). In bilateral cases, operative time did not differ significantly ($p=0.18$), although the bilateral LEVUR subgroup was small (n=8). Urethral catheter duration was significantly shorter after LEVUR ($p<0.001$), but mean hospital stay was similar ($p=0.24$) because children undergoing TVUR were discharged with the catheter in place for removal in the outpatient clinic.

Complication rates were low and comparable between groups (Table III). [Insert the type and Clavien–Dindo grade of each of the 4 complications after LEVUR and 5 after TVUR, e.g., transient urinary retention, febrile UTI, haematuria, port-site infection, ureteric obstruction.] No procedure required conversion to open surgery [confirm]. Re-operation was required in 2 children after LEVUR and 1 after TVUR ($p=0.70$). Reflux

resolved in [__]% after LEVUR and [__]% after TVUR (p=[__]) at a mean follow-up of [__] months. No child developed de novo voiding dysfunction requiring intervention after bilateral LEVUR [confirm].

IV. DISCUSSION

This 15-year single-centre study, one of the larger comparative cohorts of minimally invasive ureteric reimplantation from India, demonstrates that LEVUR and TVUR are equally safe and effective in children with VUR. Neither complication rates nor re-operation rates differed between the techniques, and both resulted in a short hospital stay. The practical differences were in operative time for unilateral cases and urethral catheterisation duration, both favoring LEVUR, while TVUR efficiently managed bilateral disease.

Our findings align with the existing literature. A systematic review and meta-analysis by Babu and Chandrasekharam reported comparable resolution and complication rates, with LEVUR generally preferred for unilateral cases and associated with a shorter hospital stay.[8] Farina et al. found a median LEVUR success rate of 96% with few complications.[9] Conversely, Benaired et al. demonstrated that the pneumovesical approach efficiently addresses both ureters in bilateral cases with a modestly longer operative time,[10] while Kojima et al. discussed technical refinements needed for the extravesical approach.[11] Our data reflect this dichotomy: LEVUR was 20 minutes faster in unilateral cases, while the two techniques converged in bilateral cases.

The most clinically significant difference in our study was catheter duration. Since LEVUR does not breach the urothelium, the catheter can be removed on the first post-operative day; after TVUR, intravesical suture lines and port-site cystotomies are conventionally protected for several days. Prolonged catheterisation in children is associated with bladder spasms, discomfort, and parental anxiety, making its avoidance a notable advantage of the extravesical approach. This did not result in a shorter hospital stay in our cohort, reflecting a policy of early discharge with the catheter in place after TVUR.

The concern historically associated with bilateral extravesical reimplantation, namely transient post-operative urinary retention due to pelvic plexus injury, was not observed to a clinically relevant degree in the small number of bilateral LEVUR cases in our series. Contemporary nerve-sparing dissection, limited to the ureterovesical junction with minimal lateral bladder mobilisation, appears to have largely mitigated this risk, as reported by others.[12] However, our bilateral LEVUR subgroup was too small to draw firm conclusions, and TVUR remains our preferred approach for bilateral disease.

An important feature of this study is that two different surgical services within the same institution practiced the techniques. This introduces selection bias and surgeon-related confounding but also reflects real-world practice in many Indian tertiary centres, where urologists and paediatric surgeons share care for children with VUR. That both approaches delivered comparable outcomes is reassuring for institutions in India that may only have expertise in one technique; the observation that laterality, rather than patient factors, was the dominant determinant of approach supports a pragmatic, laterality-based algorithm for technique selection that can be applied in resource-constrained settings without additional equipment.

The retrospective design, non-randomised allocation, different surgical teams, and the significant laterality imbalance between the groups are the main limitations. Subgroup analyses of bilateral LEVUR (n=8) and unilateral TVUR (n=10) were underpowered. Operative times reflect a 15-year period during which the learning curve for both techniques evolved. Long-term data on renal function, new scarring, and voiding symptoms were not uniformly available. A prospective study stratified by laterality is needed to confirm these findings.

In summary, LEVUR and TVUR are equally effective and safe minimal-access procedures for paediatric VUR, with low complication and re-operation rates. LEVUR is particularly suited to unilateral reflux, offering shorter operative time and catheter removal within 24 hours; TVUR is suited to bilateral reflux, permitting efficient simultaneous correction of both ureters. Laterality and institutional expertise, rather than a single preferred technique, should guide the choice of approach.

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[Acknowledge non-author contributors, e.g., medical records staff, statistician; or state 'None'.]

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TABLE I. Baseline characteristics of children undergoing laparoscopic extravesical (LEVUR) and transvesicoscopic (TVUR) ureteric reimplantation

Characteristic	LEVUR (n=60)	TVUR (n=46)	p value
Age (years), mean (SD)	4.8 (2.1)	5.1 (2.4)	[__]
Sex, male:female	22:38	18:28	[__]
High-grade reflux (grade IV–V), n (%)	38 (63)	30 (65)	[__]
Prior febrile UTI, n (%)	48 (80)	39 (85)	[__]
Pre-existing renal scars on DMSA, n (%)	16 (26)	14 (30)	[__]

LEVUR laparoscopic extravesical ureteric reimplantation; TVUR transvesicoscopic ureteric reimplantation; SD standard deviation; UTI urinary tract infection; DMSA dimercaptosuccinic acid scintigraphy. Exact p values to be inserted.

TABLE II. Laterality of reflux and peri-operative outcomes

Variable	LEVUR (n=60)	TVUR (n=46)	p value
Laterality, n (%)			
Unilateral reflux	52 (86.7)	10 (21.7)	<0.001
Bilateral reflux	8 (13.3)	36 (78.3)	<0.001
Operative time (minutes), mean (SD)			
Unilateral cases	90 (15)	110 (18)	0.01
Bilateral cases	140 (20)	150 (22)	0.18
Urethral catheter duration (days), mean	1.2	6.0	<0.001
Hospital stay (days), mean (SD)	2.1 (0.6)	2.3 (0.7)	0.24

LEVUR laparoscopic extravesical ureteric reimplantation; TVUR transvesicoscopic ureteric reimplantation; SD standard deviation. Operative time for bilateral cases includes both sides.

TABLE III. Complications, re-operation and reflux resolution

Outcome	LEVUR (n=60)	TVUR (n=46)	p value
Any complication, n (%)	4 (6.6)	5 (10.8)	0.42
Re-operation, n (%)	2 (3.3)	1 (2.1)	0.70
Reflux resolution on VCUG, n (%)	[__]	[__]	[__]

LEVUR laparoscopic extravesical ureteric reimplantation; TVUR transvesicoscopic ureteric reimplantation; VCUG voiding cystourethrography. Counts derived from reported percentages; confirm against source data and add Clavien–Dindo grade of each complication as a footnote.

LEGENDS TO FIGURES

FIG 1. Laparoscopic extravesical ureteric reimplantation. (a) Mobilisation of the distal ureter to the ureterovesical junction. (b) Creation of the detrusor tunnel with the bladder mucosa intact. (c) Completed detrusorrhaphy over the ureter. (d) Re-peritonealisation of the repair.

FIG 2. Transvesicoscopic ureteric reimplantation under carbon dioxide pneumovesicum. (a) Intravesical mobilisation of the ureteric orifice. (b) Creation of the cross-trigonal submucosal tunnel with the ureter intubated.

FIGURES

FIG 1.

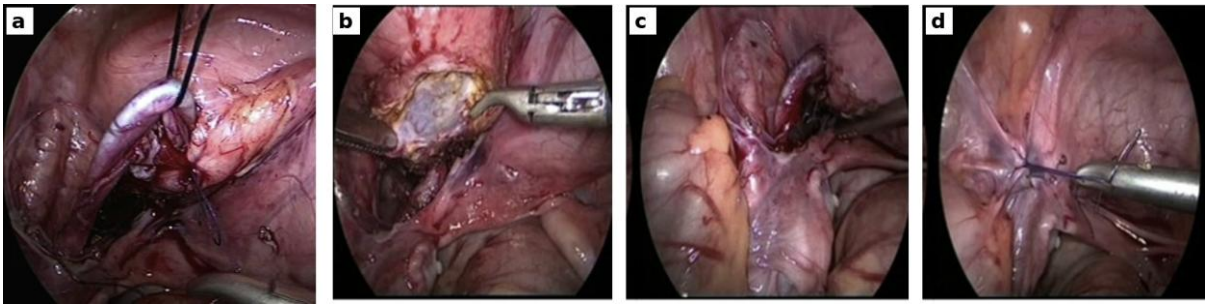

FIG 2.