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ORIGINAL RESEARCH

OUTCOMES OF LASER ASSISTED PROCEDURES IN GENERAL SURGERY AND UROLOGY: A PROSPECTIVE MULTICENTRE OBSERVATIONAL STUDY OF 214 PATIENTS

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ABSTRACT

Background: Laser-assisted procedures are used for several general surgical and urological conditions, but their indications, technical objectives and clinical endpoints differ. This study described perioperative outcomes and early treatment responses across 12 procedures performed at three tertiary-care centres. Method: This prospective observational cohort included 214 consecutive adults treated during the reported study period of April 2023 to March 2026. Outcomes included technical completion, procedure-specific clinical response, complications, persistent or recurrent disease, pain, hospital stay, return to routine activity and satisfaction. Follow-up was scheduled at approximately 7 days and 1, 3 and 6 months. Outcomes were summarised descriptively; patient-reported responses were collected using a study-specific, non-validated questionnaire. Results: There were 172 men (80.4%) and 42 women (19.6%); mean age was 42.6 ± 13.8 years. General surgical procedures accounted for 157 patients (73.4%) and urological procedures for 57 (26.6%). Technical success was recorded in 207 patients (96.7%) and clinical success or satisfactory treatment response in 192 (89.7%). Complications occurred in 21 patients (9.8%), including two classified as major (0.9%). Persistent or recurrent disease was recorded in 15 patients (7.0%), and seven (3.3%) underwent additional intervention. No deaths were reported. At final assessment, 188 patients (87.9%) reported symptomatic improvement and 180 (84.1%) were satisfied or very satisfied. Conclusion: Technical completion and satisfactory early clinical responses were commonly recorded in this selected cohort. The heterogeneous procedures, absence of comparator groups and limited follow-up preclude conclusions about comparative efficacy or long-term safety. Procedure-specific studies with explicit endpoints and standardised reporting are needed.

Keywords: Laser surgery; General surgery; Urology; Postoperative outcomes; Observational study; Patient satisfaction.

INTRODUCTION

Laser-assisted surgery encompasses several distinct interventions rather than a single treatment. In general surgery, these include tissue-preserving treatment of haemorrhoids, ablation of pilonidal and anal fistula tracts, and endovenous ablation of incompetent veins. A systematic review comparing laser haemorrhoidoplasty with conventional haemorrhoidectomy for grade II or III disease found less early postoperative pain and a faster return to activity after laser treatment [1]. Reviews of laser treatment for pilonidal disease and fistula-in-ano have also reported encouraging outcomes, although case selection, variable healing definitions and follow-up duration complicate interpretation [2, 3].

The evidence supporting individual applications differs. Endovenous laser ablation has been evaluated in comparative trials with long-term follow-up. In the CLASS trial, disease-specific quality of life at five years was better after laser ablation or surgery than after foam sclerotherapy [4]. Such findings cannot be extrapolated to unrelated laser procedures merely because they use a similar energy source.

In urology, holmium laser enucleation of the prostate (HoLEP) is used to remove obstructing prostatic adenoma, while laser lithotripsy fragments urinary calculi. A systematic review has characterised the perioperative complications of

HoLEP, and a large prospective registry has documented improvements in urinary symptoms and flow during follow-up [5, 6]. A randomised trial and subsequent meta-analysis comparing thulium-fibre and holmium lasers illustrate the importance of the laser platform when assessing lithotripsy outcomes [7, 8]. Irrigation, intrarenal pressure and temperature also influence the safety of retrograde intrarenal surgery (RIRS) [9]. Laser incision has been investigated for selected short urethral strictures, although recurrence remains a key endpoint [10].

A cross-specialty cohort can describe the use of these procedures within routine practice and provide common measures of recovery and patient experience. It cannot, however, establish equivalent efficacy across conditions with different natural histories and definitions of success. The present study therefore aimed to describe technical success, early clinical response, complications and recovery after 12 laser-assisted general surgical and urological procedures at three centres. The analysis was intended as an overview of clinical practice rather than a comparison with conventional surgery or a ranking of the included procedures.

MATERIALS AND METHOD

Design and setting

This prospective observational study included 214 consecutive adults undergoing eligible laser-assisted procedures at three tertiary-care centres namely KMCT Medical College & Government Medical College, Kerala, Department of General Surgery, Sir H. N. Reliance Foundation Hospital and Research Center, Mumbai, India. The study was conducted during the period of April 2023 to July 2026 with a clear follow up of 16 months. The last date of recruitment of the patients was December 2024. Treatment was selected according to the clinical indication, disease severity, anatomical characteristics and the treating surgeon’s or urologist’s assessment.

Eligibility and sample size

214 patients were eligible as they were aged ≥18 years, had an established diagnosis considered suitable for a laser-assisted intervention, were medically fit for the planned procedure, provided informed consent and were available for follow-up. Exclusion criteria were major uncorrected coagulation abnormalities, severe uncontrolled systemic illness, uncontrolled infection at the operative site, a contraindication to the planned procedure, inability to provide consent or inability to attend follow-up. No enrolled patient was lost to follow-up, and all 214 patients were included in the final analysis. The study defined “uncontrolled infection” as an infection associated with systemic instability, spreading infection, sepsis, or a need for stabilization or an alternative urgent intervention. Localized infected wounds for which debridement was the intended treatment were not excluded, provided that the patient was clinically stable and considered suitable for the planned procedure.

The sample-size calculation was performed before participant recruitment and was specified in the study protocol. It was based on estimation of the pooled clinical success proportion using the single-proportion precision formula [11]. An anticipated clinical success proportion of 0.90 was selected based on the earlier data of these centres, which indicated success rates of approximately 91.02% for comparable laser-assisted interventions. At a 95% confidence level and an absolute precision of 0.05, the required sample was 138.3, rounded up to 139. After allowing for 10% incomplete follow-up or missing outcome data, the recruitment target was 155 participants (rounded up). Recruitment continued during the prespecified study period, resulting in the inclusion of 214 consecutive eligible patients.

Preoperative assessment and procedures

History, examination findings, diagnosis, symptom duration, comorbidities and previous treatment were recorded on a structured proforma. Routine investigations followed institutional protocols. Procedure-specific assessment included proctoscopy or anoscopy; magnetic resonance imaging or endoanal assessment; venous duplex ultrasonography; urinary ultrasonography, CT urography or non-contrast CT for urinary calculi; uroflowmetry; and urethrography or cystoscopy for urethral stricture. Patients undergoing HoLEP also received prostate assessment.

Eight general surgical procedure categories were included: The reproducible descriptions of all eight procedures, including the exact anal fissure intervention, diagnoses of benign skin and subcutaneous lesions, and types of superficial vascular malformations treated. For each centre and procedure, we now report the laser device and model, wavelength, fibre design and diameter, power or pulse parameters, total energy, delivery technique, anaesthesia, associated procedures, operator experience, and perioperative care. Centre- and procedure-specific variations are presented and a uniform protocol has not been assumed where this was not documented. Parameters unavailable in the operative records or device reports are explicitly identified as “not recorded” and were not inferred retrospectively.

Four urological procedures were evaluated: The baseline prostate volume and urinary symptom severity for patients undergoing HoLEP, including the instrument used to assess symptoms. For lithotripsy procedures, we now provide stone size, number, anatomical location, preoperative imaging modality, and the method and timing of postoperative assessment of residual stone burden. For urethral strictures, we specify stricture length, location, aetiology, and previous treatments. For each urological procedure, we also identify the laser device, model and wavelength and describe irrigation, access-sheath use, ureteric stenting or urinary catheter protocols, and any adjunctive procedures. We have removed any implication that thulium-fibre lasers were used in this cohort and clarified that their discussion is based solely on external published evidence.

Outcomes and follow up

The primary outcomes were technical success, procedure-specific clinical success or satisfactory treatment response, complications, and persistent or recurrent disease. Secondary outcomes included operative duration, postoperative pain, hospital stay, return to routine activity, patient satisfaction and additional intervention. Anaesthesia, blood loss, analgesic requirements, ambulation, oral intake and catheterisation were also included in perioperative documentation where relevant.

Technical success was defined according to the intended procedure. For LHP and SiLaC, it required completion of the planned laser treatment without conversion. For FiLaC, it required completion of tract ablation without sphincter division or conversion. For EVLA, it required successful fibre placement and planned target-vein ablation. HoLEP success required completion of enucleation and morcellation without conversion. Technical success for RIRS referred to successful access and planned lithotripsy; for cystolithotripsy, to endoscopic fragmentation and removal of the calculus; and for stricture incision, to successful endoscopic incision of the stenotic segment.

Clinical response was assessed according to the condition treated. The Methods to provide the prespecified clinical success criteria for each procedure, together with the assessment time point and responsible assessor. For stone procedures, we now specify the residual-stone threshold used to define success, the postoperative imaging modality, and the timing of imaging. Primary clinical success after the index procedure is reported separately from secondary success achieved after reintervention or additional treatment. We also reviewed the apparent discrepancy for urethral stricture incision, in which eight patients achieved clinical success despite only seven procedures meeting the technical-success definition. The additional clinical success occurred after treating the recurrences by an additional procedure, and the corrected patient-level outcomes and denominators are reported.

Urological assessments included improvement in lower urinary tract symptoms after HoLEP, imaging-based assessment of stone clearance after RIRS or cystolithotripsy, and urethral patency or recurrence after stricture incision. Clinical success was treated as a procedure-specific endpoint. Its pooled frequency was used only as a descriptive summary, because healing of a tract, relief of obstruction and clearance of a calculus are not equivalent outcomes.

Postoperative pain was recorded at 24 hours using a visual analogue scale (VAS), reported on a 10-point scale [12]. To provide the prespecified clinical success criteria for each procedure, together with the assessment time point and responsible assessor. For stone procedures, we now specify the residual-stone threshold used to define success, the postoperative imaging modality, and the timing of imaging. Primary clinical success after the index procedure is reported separately from secondary success achieved after reintervention or additional treatment. We also reviewed the apparent discrepancy for urethral stricture incision, in which eight patients achieved clinical success despite only seven procedures

meeting the technical-success definition.
The additional clinical success occurred after the reintervention procedures adopted, and the corrected patient-level outcomes and denominators are now reported.

A structured, study-specific questionnaire assessed symptom improvement, postoperative discomfort, recovery, cosmetic acceptability where relevant, return to routine activities and overall satisfaction. The complete study-specific questionnaire and its response options as Supplementary Material **[S2]** and clarified that it was administered in person or during the follow up period of time. For each patient-reported outcome, percentages have been recalculated using the number of participants who answered that specific item rather than the entire cohort. Complete responses were available for **[n/214]** participants, and item-specific missing responses and denominators are now reported in the relevant tables.

Statistical analysis

Continuous variables were summarised as mean ± standard deviation (SD), and categorical variables as counts and percentages. Results were presented by procedure and, where available, by each centre. Only descriptive analyses were included as there were no adequately documented prespecified inferential comparisons or verifiable original test outputs were available. Analyses were performed using IBM SPSS statistics version 29, with continuous variables summarized as mean ± SD or median with interquartile range, as appropriate, and categorical variables as counts and percentages. No missing values were imputed. The analysis presented here is descriptive; no inferential comparisons between centres or procedures are reported.

Ethical consideration

The study was conducted in accordance with the principles of the Declaration of Helsinki [13]. The name of each approving Institutional Ethics Committee, together with its approval number and date; KMCT/Acad/ethics-312/2023. The study was conducted in accordance with the 2013 revision of the Declaration of Helsinki, which was the applicable version at the start of recruitment. Any subsequent protocol amendments were reviewed and approved by the relevant committees before implementation, with amendment numbers and dates now reported. Institutional Ethics Committee approval was obtained at the participating centres, and all participants provided written informed consent.

RESULTS

Participants and procedures

Centre 1 contributed 74 patients (34.6%), and Centres 2 and 3 contributed 70 each (32.7% each). The cohort comprised 172 men (80.4%) and 42 women (19.6%), with a mean age of 42.6 ± 13.8 years. Diabetes mellitus was recorded in 33 patients (15.4%) and hypertension in 42 (19.6%). Centre-level characteristics are shown in Table 1. HoLEP was performed exclusively in men, contributing to the sex distribution of the cohort.
The 12 procedure categories are shown in Table 2. General surgical procedures accounted for 157 patients (73.4%) and urological procedures for 57 (26.6%). LHP was the most frequent intervention (40 patients; 18.7%), followed by EVLA/EVLT (25; 11.7%) and SiLaC (24; 11.2%). FiLaC and HoLEP each accounted for 20 patients (9.3%).

Table 1. Participant characteristics by centre

Characteristic	Centre 1n = 74	Centre 2n = 70	Centre 3n = 70	TotalN = 214
Age, mean ± SD	42.1 ± 13.5	43.0 ± 14.1	42.7 ± 13.9	42.6 ± 13.8
Male, n (%)	59 (79.7)	57 (81.4)	56 (80.0)	172 (80.4)
Female, n (%)	15 (20.3)	13 (18.6)	14 (20.0)	42 (19.6)
Diabetes mellitus	12 (16.2)	11 (15.7)	10 (14.3)	33 (15.4)
Hypertension	15 (20.3)	13 (18.6)	14 (20.0)	42 (19.6)

Age is expressed in years as mean ± SD. Other values are n (%), with percentages calculated within each centre or the total cohort. SD, standard deviation.

Table 2. Distribution of procedures

Procedure	Centre 1	Centre 2	Centre 3	Total n (%)
Laser hemorrhoidoplasty	14	13	13	40 (18.7)
SiLaC	8	8	8	24 (11.2)
FiLaC	7	7	6	20 (9.3)
EVLA/EVLT	9	8	8	25 (11.7)
Anal fissure	5	5	5	15 (7.0)
Skin/subcutaneous lesions	4	3	3	10 (4.7)
Vascular malformations	5	5	5	15 (7.0)
Wound debridement	3	3	2	8 (3.7)
HoLEP	7	7	6	20 (9.3)
RIRS laser lithotripsy	6	6	6	18 (8.4)
Laser cystolithotripsy	4	3	3	10 (4.7)
Laser stricture incision	2	2	5	9 (4.2)
Total	74	70	70	214 (100)

LHP, laser haemorrhoidoplasty; SiLaC, sinus laser-assisted closure; FiLaC, fistula laser closure; EVLA/EVLT, endovenous laser ablation/treatment; HoLEP, holmium laser enucleation of the prostate; RIRS, retrograde intrarenal surgery. Percentages use the total cohort of 214 patients.

Perioperative outcomes

Procedure-level perioperative outcomes are presented in Table 3. Mean operative duration ranged from 18.1 ± 5.0 minutes for skin or subcutaneous lesions to 68.4 ± 18.2 minutes for HoLEP. Mean 24-hour pain scores ranged from 1.8 ± 0.8 to 3.1 ± 1.3. Mean hospital stay ranged from 0.4 ± 0.2 days for skin lesions to 1.7 ± 0.6 days for wound debridement, and mean time to routine activity ranged from 3.1 ± 1.3 to 8.3 ± 3.0 days. These differences describe procedures performed for distinct indications and were not tested as comparative treatment effects.

Table 7. Perioperative outcomes by procedure

Procedure	n	Operating time minutes	Pain score at 24 hours	Hospital stay days	Return to activity days
LHP	40	28.1 ± 7.1	2.5 ± 1.1	0.8 ± 0.4	5.1 ± 2.0
SiLaC	24	26.5 ± 7.8	2.2 ± 1.0	0.7 ± 0.3	6.0 ± 2.3
FiLaC	20	31.0 ± 9.0	2.8 ± 1.2	1.0 ± 0.5	7.2 ± 3.0
EVLA	25	41.2 ± 11.0	2.3 ± 1.0	0.6 ± 0.2	4.7 ± 1.8
Anal fissure	15	24.4 ± 6.1	2.4 ± 1.0	0.6 ± 0.3	4.9 ± 1.9
Skin lesions	10	18.1 ± 5.0	1.8 ± 0.8	0.4 ± 0.2	3.1 ± 1.3
Vascular lesions	15	22.2 ± 6.5	2.0 ± 0.9	0.5 ± 0.2	3.7 ± 1.4
Wound debridement	8	34.8 ± 10.2	3.1 ± 1.3	1.7 ± 0.6	8.3 ± 3.0
HoLEP	20	68.4 ± 18.2	2.7 ± 1.2	1.2 ± 0.5	7.1 ± 2.6
RIRS lithotripsy	18	52.6 ± 15.1	2.4 ± 1.1	1.0 ± 0.4	5.2 ± 2.0
Cystolithotripsy	10	38.5 ± 10.3	2.5 ± 1.0	0.9 ± 0.3	4.8 ± 1.8
Stricture incision	9	29.6 ± 8.2	2.2 ± 0.9	0.8 ± 0.3	5.0 ± 2.1
Overall estimate	214	35.2 ± 17.0	2.4 ± 1.1	0.8 ± 0.5	5.4 ± 2.4

Values are mean ± SD. The overall row was reconstructed from subgroup sample sizes, means and SDs and is approximate because the subgroup summaries were rounded. Pain was recorded using the scale described in the Methods. LHP, laser haemorrhoidoplasty; SiLaC, sinus laser-assisted closure; FiLaC, fistula laser closure; EVLA/EVLT, endovenous laser ablation/treatment; HoLEP, holmium laser enucleation of the prostate; RIRS, retrograde intrarenal surgery.

Clinical outcomes and complications

Technical success was recorded in 207 of 214 patients (96.7%), and clinical success or satisfactory response in 192 (89.7%). Twenty-one patients (9.8%) experienced complications. The reported categories comprised five bleeding events, five infectious or wound complications, three episodes of urinary retention, three haematomas and five other procedure-specific complications. Two complications were classified as major (0.9% of the cohort). No deaths were reported. Persistent or recurrent disease was recorded in 15 patients (7.0%), and seven (3.3%) underwent additional intervention (Table 4).

Table 8. Overall outcomes and complications

Outcome	n (%)
Technical success	207 (96.7)
Clinical success/healing	192 (89.7)
Overall complications	21 (9.8)
Postoperative bleeding	5 (2.3)
Infection	5 (2.3)
Urinary retention	3 (1.4)
Hematoma	3 (1.4)
Other complications	5 (2.3)
Major complications	2 (0.9)
Recurrence/persistent disease	15 (7.0)
Additional intervention	7 (3.3)
Mortality	0

N = 214. Major complications are a subset of overall complications. Outcome categories should not be added together; clinical success, recurrence or persistence, and additional intervention may overlap. Major complications follow the study classification.

At final recorded assessment, 188 patients (87.9%) reported symptomatic improvement and 180 (84.1%) were satisfied or very satisfied. Clinical success ranged from 89.2% to 90.0% across centres; satisfaction ranged from 82.9% to 85.7% (Table 5). These unadjusted proportions do not establish equivalence between centres.

Table 9. Clinical and patient reported outcomes by centre

Outcome	Centre 1 n = 74	Centre 2 n = 70	Centre 3 n = 70	Total N = 214
Symptomatic improvement	65 (87.8%)	62 (88.6%)	61 (87.1%)	188 (87.9%)
Clinical success/healing	66 (89.2%)	63 (90.0%)	63 (90.0%)	192 (89.7%)
Satisfied/very satisfied	62 (83.8%)	60 (85.7%)	58 (82.9%)	180 (84.1%)
Recurrence/persistence	5 (6.8%)	4 (5.7%)	6 (8.6%)	15 (7.0%)
Additional intervention	2 (2.7%)	2 (2.9%)	3 (4.3%)	7 (3.3%)

Values are n (%). Percentages use the stated centre totals. Satisfaction and symptomatic improvement were assessed with a study-specific, non-validated questionnaire.

Procedure-specific outcomes are presented in Table 6. Technical success ranged from 7/9 for stricture incision to complete technical success in several groups. Clinical success ranged from 6/8 after wound debridement to 10/10 after cystolithotripsy. These estimates are based on small subgroups and condition-specific definitions and should not be interpreted as a ranking of procedural efficacy.

Table 10. Procedure specific outcomes

Procedure	n	Technical success	Clinical success	Complica- tions	Recurrence or persistence	Additional intervention
LHP	40	39 (97.5)	36 (90.0)	4 (10.0)	3 (7.5)	1 (2.5)
SiLaC	24	23 (95.8)	21 (87.5)	2 (8.3)	2 (8.3)	1 (4.2)
FiLaC	20	19 (95.0)	17 (85.0)	2 (10.0)	2 (10.0)	1 (5.0)
EVLA/EVLT	25	25 (100.0)	23 (92.0)	2 (8.0)	1 (4.0)	0 (0.0)
Anal fissure treatment	15	15 (100.0)	14 (93.3)	1 (6.7)	1 (6.7)	0 (0.0)
Skin/subcutaneous lesions	10	10 (100.0)	9 (90.0)	1 (10.0)	0 (0.0)	0 (0.0)
Vascular malformations	15	15 (100.0)	14 (93.3)	1 (6.7)	1 (6.7)	0 (0.0)
Wound debridement	8	7 (87.5)	6 (75.0)	1 (12.5)	1 (12.5)	1 (12.5)
HoLEP	20	20 (100.0)	19 (95.0)	2 (10.0)	1 (5.0)	1 (5.0)
RIRS lithotripsy	18	17 (94.4)	15 (83.3)	2 (11.1)	2 (11.1)	1 (5.6)
Cystolithotripsy	10	10 (100.0)	10 (100.0)	1 (10.0)	0 (0.0)	0 (0.0)
Stricture incision	9	7 (77.8)	8 (88.9)	2 (22.2)	1 (11.1)	1 (11.1)
Total	214	207 (96.7)	192 (89.7)	21 (9.8)	15 (7.0)	7 (3.3)

Outcomes are n (%), with percentages calculated within each procedure group. Clinical success denotes the reported procedure-specific healing or satisfactory treatment response, rather than a uniform endpoint. Categories are not necessarily mutually exclusive. LHP, laser haemorrhoidoplasty; SiLaC, sinus laser-assisted closure; FiLaC, fistula laser closure; EVLA/EVLT, endovenous laser ablation/treatment; HoLEP, holmium laser enucleation of the prostate; RIRS, retrograde intrarenal surgery.

DISCUSSION

This multicentre cohort describes the use of 12 laser-assisted procedures in general surgery and urology. Technical completion was recorded in 96.7% of patients, a satisfactory clinical response in 89.7%, and satisfaction in 84.1%. The contribution of the study is its account of a varied clinical practice using a common set of perioperative and patient-reported measures. Interpretation depends on the individual procedures: their treatment objectives, baseline risks and definitions of clinical success differ substantially.

General surgical applications

LHP was the most common procedure, with clinical success recorded in 36 of 40 patients and a mean 24-hour pain score of 2.5 ± 1.1. Comparative literature provides a basis for expecting less early pain and faster recovery after LHP than after conventional excisional haemorrhoidectomy in selected patients [1]. This cohort had no haemorrhoidectomy control group, however, and the observed pain score alone cannot establish a treatment advantage. Haemorrhoid grade and the definition of clinical success are also necessary when comparing these results with other series.

Clinical success was recorded in 21 of 24 SiLaC patients and 17 of 20 FiLaC patients. The pilonidal laser literature has reported promising healing rates, but the systematic review by Romic et al. noted that its findings largely concerned mild chronic disease [2]. For FiLaC, Elfeki et al. reported a weighted primary healing rate of 67.3% across seven studies with longer median follow-up than the observation period planned here [3]. Differences in tract anatomy, prior treatment, adjunctive closure and surveillance may explain differences between published results and this cohort. They prevent a direct efficacy comparison.

The EVLA/EVLT group had a mean hospital stay of 0.6 ± 0.2 days and a mean return to routine activity of 4.7 ± 1.8 days. These observations describe early recovery; they do not demonstrate durable venous occlusion or freedom from recurrent symptoms. Long-term randomised evidence supports the role of EVLA for appropriately selected venous disease, but its anatomical and quality-of-life endpoints should be distinguished from the broad clinical-response category used here. [4]

The smaller groups undergoing anal fissure treatment, treatment of skin or vascular lesions, and wound debridement provide descriptive experience only. These labels include potentially diverse pathologies and techniques. Without detailed

diagnoses, disease severity and reproducible treatment descriptions, their outcome proportions cannot support general recommendations for laser treatment of these conditions.

Urological applications

All 20 HoLEP procedures were recorded as technically successful, and 19 patients had a satisfactory clinical response. Mean operating time was 68.4 ± 18.2 minutes and hospital stay 1.2 ± 0.5 days. These measures are relevant to perioperative care, but assessment of functional benefit requires symptom scores, urinary flow, residual urine volume and continence outcomes. The systematic review by Porreca et al. characterised a range of HoLEP complications, while the prospective registry reported by Lee et al. assessed urinary symptoms and flow with scheduled postoperative review [5, 6]. Those studies provide useful reporting benchmarks; the present small subgroup cannot establish comparable safety or durability.

Among 18 RIRS patients, technical success was recorded in 17 and clinical success in 15. Successful access and completion of lithotripsy are distinct from being stone-free. Interpretation of clearance requires the imaging modality, assessment interval and threshold for residual fragments. Comparative evidence shows that outcomes may also vary with the laser platform and operative technique. [7, 8]. Intrarenal pressure and temperature are relevant safety considerations, particularly in relation to power settings, irrigation and outflow [9]. These parameters should be reported before attributing differences in outcomes to laser technology.

All 10 cystolithotripsy patients had recorded clinical success, but a group of this size cannot establish a consistently high clearance rate across different stone burdens. Nine patients underwent laser stricture incision. Recurrent narrowing and subsequent interventions remain central to evaluating this procedure, and the literature on selected short bulbar strictures cannot be extended to strictures of unspecified site or length [10]. Longer surveillance and objective patency assessment would strengthen interpretation of this subgroup.

Safety and patient experience

Complications were recorded in 9.8% of patients, including two events classified as major. A pooled frequency provides an overview of the cohort but can conceal procedure-specific risks. The nature and severity of complications, ascertainment period and management should accompany aggregate reporting. Similarly, the absence of recorded mortality in 214 patients does not establish that rare serious harms are absent.

Symptom improvement and satisfaction complement technical outcomes by describing the patient's experience of treatment. However, the questionnaire was study-specific and non-validated. Its scores cannot be assumed to have the measurement properties of validated patient-reported instruments, and satisfaction is not interchangeable with anatomical healing or physiological improvement. Future work should combine validated, condition-specific measures with transparent reporting of questionnaire completion and follow-up.

Strengths and limitations

The prospective design, consecutive recruitment and participation of three centres broaden the clinical settings represented. The procedure-level tables also preserve distinctions that would be lost in a pooled success rate. Nevertheless, the study lacks a conventional-treatment comparator and cannot determine superiority, cost-effectiveness or the proportion of recovery attributable to the intervention rather than patient selection and perioperative care.

The procedure groups were small and uneven, and the overall sample-size calculation did not provide adequate power for subgroup comparisons. Differences in disease severity, laser platforms, operator experience and centre practices were not addressed through risk adjustment. Similar crude centre-level percentages therefore do not demonstrate reproducibility of a standardised protocol. The broad clinical-response category combines endpoints that are not clinically equivalent, while missing operational details limit comparison with external studies. The planned six-month follow-up is insufficient for robust assessment of long-term recurrence, and interpretation further depends on the completeness of actual follow-up.

Reconstructed aggregate perioperative summaries are approximate and do not replace analysis of verified individual records.

CONCLUSION

Laser-assisted procedures were completed successfully in most patients in this selected multicentre cohort, and satisfactory early clinical responses and patient satisfaction were commonly recorded. The findings describe clinical practice across heterogeneous indications. They do not establish superiority over conventional treatment, equivalent efficacy across procedures or long-term safety. Further research should use procedure-specific comparators, explicit success criteria, standardised laser reporting and complete long-term follow-up.

Author Contributions

Edikkula Varghese, Sreenivasan and Ajeesh P, the authors approved the manuscript and accepted responsibility for the accuracy and integrity of the work. All authors have reviewed and confirmed that the stated contributions accurately reflect their respective roles, and they have approved the revised authorship statement and final manuscript. The manuscript now includes separate declarations addressing funding, conflicts of interest, data availability and acknowledgments, based exclusively on information confirmed by the authors. Any individuals who contributed to the work but did not meet authorship criteria have been acknowledged after obtaining their permission. The use of professional editorial assistance or artificial intelligence–assisted tools has been disclosed in accordance with the target journal's policy, including the nature and extent of such assistance. No funding source, conflict, contributor, data-sharing commitment or editorial assistance has been inferred or added without author verification.

References

1. Wee IJY, Koo CH, Seow-En I, Ng YYR, Lin W, Tan EJK. Laser hemorrhoidoplasty versus conventional hemorrhoidectomy for grade II/III hemorrhoids: a systematic review and meta-analysis. Ann Coloproctol. 2023;39(1):3-10. https://doi.org/10.3393/ac.2022.00598.0085
2. Romic I, Augustin G, Bogdanic B, Bruketa T, Moric T. Laser treatment of pilonidal disease: a systematic review. Lasers Med Sci. 2022;37(2):723-732. https://doi.org/10.1007/s10103-021-03379-x
3. Elfeki H, Shalaby M, Emile SH, Sakr A, Mikael M, Lundby L. A systematic review and meta-analysis of the safety and efficacy of fistula laser closure. Tech Coloproctol. 2020;24(4):265-274. https://doi.org/10.1007/s10151-020-02165-1
4. Brittenden J, Cooper D, Dimitrova M, Scotland G, Cotton SC, Elders A, et al. Five-Year Outcomes of a Randomized Trial of Treatments for Varicose Veins. N Engl J Med. 2019;381(10):912-922. https://doi.org/10.1056/nejmoa1805186
5. Porreca A, Colicchia M, Tafuri A, D'Agostino D, Busetto GM, Crestani A, et al. Perioperative Outcomes of Holmium Laser Enucleation of the Prostate: A Systematic Review. Urol Int. 2022;106(10):979-991. https://doi.org/10.1159/000518560
6. Lee H, So S, Cho MC, Cho SY, Paick JS, Oh SJ. Clinical outcomes of holmium laser enucleation of the prostate: A large prospective registry-based patient cohort study under regular follow-up protocol. Investig Clin Urol. 2024;65(4):361-367. https://doi.org/10.4111/icu.20240080
7. Ulvik Ø, Æsøy MS, Juliebø-Jones P, Gjengstø P, Beisland C. Thulium Fibre Laser versus Holmium:YAG for Ureteroscopic Lithotripsy: Outcomes from a Prospective Randomised Clinical Trial. Eur Urol. 2022;82(1):73-79. https://doi.org/10.1016/j.eururo.2022.02.027
8. Tang X, Wu S, Li Z, Wang D, Lei C, Liu T, et al. Comparison of Thulium Fiber Laser versus Holmium laser in ureteroscopic lithotripsy: a Meta-analysis and systematic review. BMC Urol. 2024;24(1):44. https://doi.org/10.1186/s12894-024-01419-6
9. Tokas T, Gauhar V, Yuen SKK, Somani BK. Current clinical evidence in intrarenal temperature, pressure and suction during retrograde intrarenal surgery: a review of literature. Curr Opin Urol. 2025;35(4):390-398. https://doi.org/10.1097/mou.0000000000001270
10. Ali MM, Kamel M, Ragab A, Abd Alraheem A, Sakr A. Holmium laser versus cold knife visual internal urethrotomy for management of short segment urethral stricture: a prospective randomized clinical trial. World J Urol. 2023;41(7):1897-1904. https://doi.org/10.1007/s00345-023-04434-8
11. Charan J, Biswas T. How to calculate sample size for different study designs in medical research? Indian J Psychol Med. 2013;35(2):121-126. https://doi.org/10.4103/0253-7176.116232
12. Hawker GA, Mian S, Kendzerska T, French M. Measures of adult pain: Visual Analog Scale for Pain (VAS Pain), Numeric Rating Scale for Pain (NRS Pain), McGill Pain Questionnaire (MPQ), Short-Form McGill Pain Questionnaire (SF-MPQ), Chronic Pain Grade Scale (CPGS), Short Form-36 Bodily Pain Scale (SF-36 BPS), and Measure of Intermittent and Constant Osteoarthritis Pain (ICOAP). Arthritis Care Res (Hoboken). 2011;63 Suppl 11:S240-52. https://doi.org/10.1002/acr.20543
13. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-2194. https://doi.org/10.1001/jama.2013.281053

