

Robotics in functional and reconstructive urology: evolutionary institutional experience and current attitudes amongst practicing urologists

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Background: The use of robotic-assisted laparoscopic (RAL) surgery in functional and reconstructive urology (FRU) has exponentially grown and has become standard of care over the past decade. We aimed to compare our experience adopting RAL surgery in FRU with current practice patterns and to discuss the implications of the RAL platform for the future of genitourinary reconstructive surgery (GURS) training.

Methods: We reviewed case logs of two GURS urologists and identified RAL cases from 2012 to 2024. Cases were categorized into: lower urinary tract (LUT), upper urinary tract (UUT), urogynecology and reconstructive pelvic surgery (URPS), fistula, extirpative, and gender affirmation. Changes in volume and distribution were evaluated over time. A REDCap survey was circulated amongst practicing urologists, asking about their experience regarding RAL-FRU surgery.

Results: A total of 1083 surgeries were captured: 165 LUT, 314 UUT, 437 URPS, 16 fistula, 94 extirpative, and 57 gender affirmation. The annual number of RAL-FRU cases increased from 23 (2012) to 158 (2024), with the biggest change seen in UUT reconstruction (4.3% to 36.1%). A total of 108 surveys were completed. The majority of respondents had been practicing for less than 10 years (59%) and in academia (57%). Of the respondents, 31% performed at least 10 RAL-FRU cases annually. The most common cases were robotic pyeloplasty (55%) and ureteral reconstruction (54%). Surgeons involved in post-graduate training reported they strongly agreed or agreed with reporting RAL-FRU cases for GURS fellows.

Conclusions: The RAL platform was rapidly adopted in FRU surgery over the past decade, particularly in UUT reconstruction. Educators should aim to incorporate robotics training for the next generation of GURS surgeons.

Key Words: robotic-assisted laparoscopic surgery, functional and reconstructive urology, genitourinary reconstructive surgery, urogynecology and reconstructive pelvic surgery, upper urinary tract reconstruction, lower urinary tract

Introduction

The development and proliferation of the robotic-assisted laparoscopic (RAL) platform has expanded the envelope of minimally invasive surgery by allowing for a greater range of motion, reduced tremor, a magnified 3-D image of the operative

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field, and physiologic information provided by near-infrared fluorescent imaging.^{1,2} Urologic oncologists have been particularly adept at adopting the RAL platform into clinical practice. From its first report of use in urology 2001, the proportion of prostatectomies completed robotically has risen to 83% by 2021.^{3,4} Studies comparing open to robotic approaches in urologic malignancies have generally found equivalent oncologic outcomes with improvement in perioperative measures in robotic cases, including blood loss, postoperative pain, and length of stay, albeit at the expense of longer operative times.⁵⁻⁷ There is evidence to suggest that the RAL platform may improve outcomes regarding post-prostatectomy vesicourethral anastomotic stenosis due to the improved visibility and dexterity in the deep pelvis.⁸⁻¹⁰

In addition to its oncologic application, there is a growing body of research that supports the application of the robotic platform to functional and reconstructive urology (FRU), particularly upper and lower urinary tract reconstruction, including pyeloplasty, ureteral strictures, bladder neck contracture, and post-cystectomy urinary diversion.¹¹⁻¹³ However, in contrast to procedures like radical prostatectomy, it is unclear to what extent practice patterns have changed to reflect these findings.¹⁴ Many FRU cases are complicated by prior surgical history, radiation sequelae, or significant trauma, which can limit the use of the robotic platform outside of specialized tertiary care centers.¹⁵ Furthermore, there is a lack of standardized robotic reconstructive training across urologic residencies and fellowships.

We aim to demonstrate our trajectory for incorporating the RAL platform at a tertiary reconstructive urology practice and to highlight the changes in attitude among urologists towards robotic surgery, especially in upper urinary tract reconstruction. These results may impact the training of future reconstructive urologists and point towards the need for a formally structured operative robotic curriculum and case log requirements within the Society of Genitourinary Reconstructive Surgeons (GURS) fellowships, particularly regarding ureteral reconstruction.¹⁶

Methods

Study cohort and case identification

We conducted a Colorado Multiple Institutional Review Board (COMIRB) IRB-exempt determined (#23-1572) retrospective chart review of the case logs of two GURS urologists (BJF, TTH) at the University of Colorado and identified all RAL cases

from 2012 to 2024. Current procedural terminology (CPT) codes were used to identify cases, which were independently reviewed by two authors. Procedures were categorized into the following subgroups: lower urinary tract (LUT), upper urinary tract (UUT), urogynecology and reconstructive pelvic surgery (URPS), fistula, extirpative, and gender affirmation surgery. Changes in surgical volume and the distribution of cases were evaluated over time.

Survey design and distribution

In addition, a survey was created using Research Electronic Data Capture (REDCap), a data collection and management platform hosted at the University of Colorado.^{17,18} The survey instrument was developed through an iterative process and underwent content validation by two fellowship-trained Genitourinary Reconstructive Surgery (GURS) urologists and one GURS fellow, with revisions made for clarity, relevance, and alignment with study objectives prior to distribution. The survey was distributed electronically to both practicing GURS and non-GURS urologists. The survey consisted of a total of 20 multiple-choice survey questions in both yes/no, multiple-choice, and Likert scale formats (Figure 1). Survey questions included demographic information, urologic surgical training, current clinical practice patterns, experience with robotic and FRU surgeries, and attitudes regarding the RAL platform in urology. An online link was circulated by GURS to their members and was compared to data collected from non-GURS members via email, social media, and at professional conferences. Surgeons involved in education, specifically training residents and fellows, were given additional questions regarding the concept of adding a section for RAL-FRU cases to the GURS fellowship case log. We conducted in-person surveys at national and regional conferences to improve survey distribution and uptake. Survey inclusion criteria encompassed attending urologists. Incomplete survey responses were excluded from analysis. All survey data were de-identified to protect participant confidentiality. The complete REDCap questionnaire is provided in full as supplementary material.

Statistical analysis

Descriptive statistical analyses of retrospective case composition and survey results were conducted as appropriate. Poisson regression was used to estimate the magnitude of change over time, with results reported as incidence rate ratios (IRRs) and 95% confidence intervals. Differences in longitudinal volume patterns across procedural domains were assessed

What About Robotics in Reconstructive Urology?

Resize font:  | 

Please complete the survey below.

Thank you!

Section 1 - Demographics

How did you access this survey?

☐ Email from professional society

☐ Social media

☐ Provided at a professional conference

reset

Approximately how many years have you been in practice?

☐ 0-10

☐ 11-20

☐ >20

reset

Have you completed a fellowship?

☐ Genitourinary Reconstructive Surgery (GURS)

☐ Female Pelvic Medicine and Reconstructive Surgery (FPMS)

☐ Endourology/Laparoscopy

☐ Oncology

☐ Other (please specify below)

☐ I have not completed a fellowship

reset

What is your primary practice setting?

☐ Academics

☐ Multispecialty Group

☐ Single Specialty Group

☐ Other

reset

FIGURE 1. Sample REDCap survey circulated to practicing urologists

using the Kruskal–Wallis test. Statistical significance $p < 0.05$. All analyses were performed using Excel.

Results

Case logs

A total of 1083 RAL-FRU cases were identified with the subgroup distribution as follows: 165 (15%) LUT, 314 (29%) UUT, 437 (40%) URPS, 94 (9%) extirpative, 16 (2%) fistula repairs, and 57 (5%) gender affirmation surgeries (Figure 2). The number of RAL-FRU cases

conducted annually within our practice increased over seven-fold from 2012 ($n = 23$) to 2024 ($n = 158$) (Figure 3). The percentage of FRU cases performed robotically also increased from 4.9% in 2012 to 16.2% in 2024. There was a decrease in overall surgical volume in 2020, corresponding to the COVID-19 pandemic and associated scheduling restrictions at our institution. This was followed by a brisk rebound and return to an upward trajectory of RAL-FRU cases in 2021 onwards (Figure 4). Changes in the subgroup distribution over time are seen in Figure 4, where

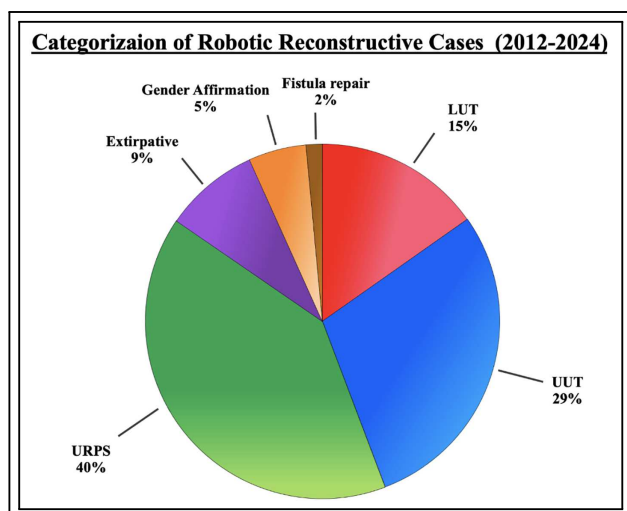


FIGURE 2. Categorization of total number of robotic functional and reconstructive urology cases (2012–2024)

four particular waves of adoption of the RAL platform are noted: URPS, followed by LUT, then UUT, and finally extirpative and gender-affirming surgeries. The largest change in RAL-FRU cases was noted within UUT reconstruction, with 4.3% of robotic cases being UUT in 2012 to 36.1% in 2024.

Over the study period, total annual case volume increased significantly ($p < 0.001$). This growth was driven primarily by a marked increase in upper urinary tract reconstruction ($p < 0.001$), as well as significant expansion in extirpative reconstructive procedures ($p < 0.001$) and gender-affirming surgery ($p < 0.001$). In contrast, URPS and LUT reconstruction demonstrated no significant temporal change, suggesting relative stabilization over time. Collectively, these findings highlight a shift in reconstructive practice toward increasing case complexity and diversification, with contemporary growth driven predominantly by upper urinary tract, extirpative, and gender-affirming reconstruction.

Survey

A total of 108 surveys were completed by practicing urologists between 2018 and 2020. The majority of respondents had been in practice for less than 10 years (59%) and practiced in an academic setting (57%). 54% ($n = 58$) of respondents had completed a fellowship after residency training, including: GURS 14% ($n = 15$), oncology 12% ($n = 13$), endourology/laparoscopic surgery 10% ($n = 11$), URPS 7% ($n = 8$), and other 10% ($n = 11$).

When asked about RAL-FRU experience and current practice patterns, 31% of respondents performed at least 10 RAL-FRU cases per year, 33% performed fewer than 10 per year, and 36% performed none, as seen in Figure 5. The most commonly performed RAL-FRU cases amongst respondents were robotic pyeloplasty (55%) and robotic ureteral reconstruction (54%). Participants reported that the majority of RAL-FRU cases at their institution were performed either by a non-fellowship-trained urologist (26%), urologic oncologist (23%), or GURS urologist (22%).

Of those involved in post-graduate urology training, 59% reported that they agreed or strongly agreed with a formalized curriculum, as well as the expansion of general reporting of surgical cases for GURS fellows to include RAL ureteral and bladder reconstruction cases. When queried regarding which RAL-FRU cases should be logged as non-index reconstructive urology cases for a GURS fellowship, participants most often selected ureteral reconstruction (66%), followed by bladder reconstruction (63%), fistula surgery (63%), urinary diversion (56%) and pyeloplasty (50%).

Discussion

The GURS urologists at our institution have successfully adopted the RAL platform across all areas of FRU over time. As a result, from 2012 to 2024, the completion of RAL-FRU cases increased over 7-fold, with the majority of the change seen between 2012 and 2018 (Figure 4). The increase in RAL-FRU cases was particularly pronounced amongst UUT reconstruction, with an increase of one robotic UUT case in 2012 to 57 cases in 2024. Notably, early adoption of RAL-FRU was driven primarily by robotic sacrocolpopexy, reflecting the primary surgeon's formal training in both male and female reconstructive urology. Surgeon experience and comfort within pelvic reconstructive surgery, coupled with the underlying patient population, guided the initial implementation of robotics in URPS before subsequent expansion into other reconstructive domains.

The disproportionate increase in robotic UUT reconstruction likely reflects several procedure-specific advantages of the robotic platform, including enhanced three-dimensional visualization, improved ergonomics for deep retroperitoneal dissection, facilitated ureteral mobilization, and greater precision during suturing, anastomosis, and graft placement. These technical benefits may lower the threshold for adoption relative to other reconstructive procedures and may explain why

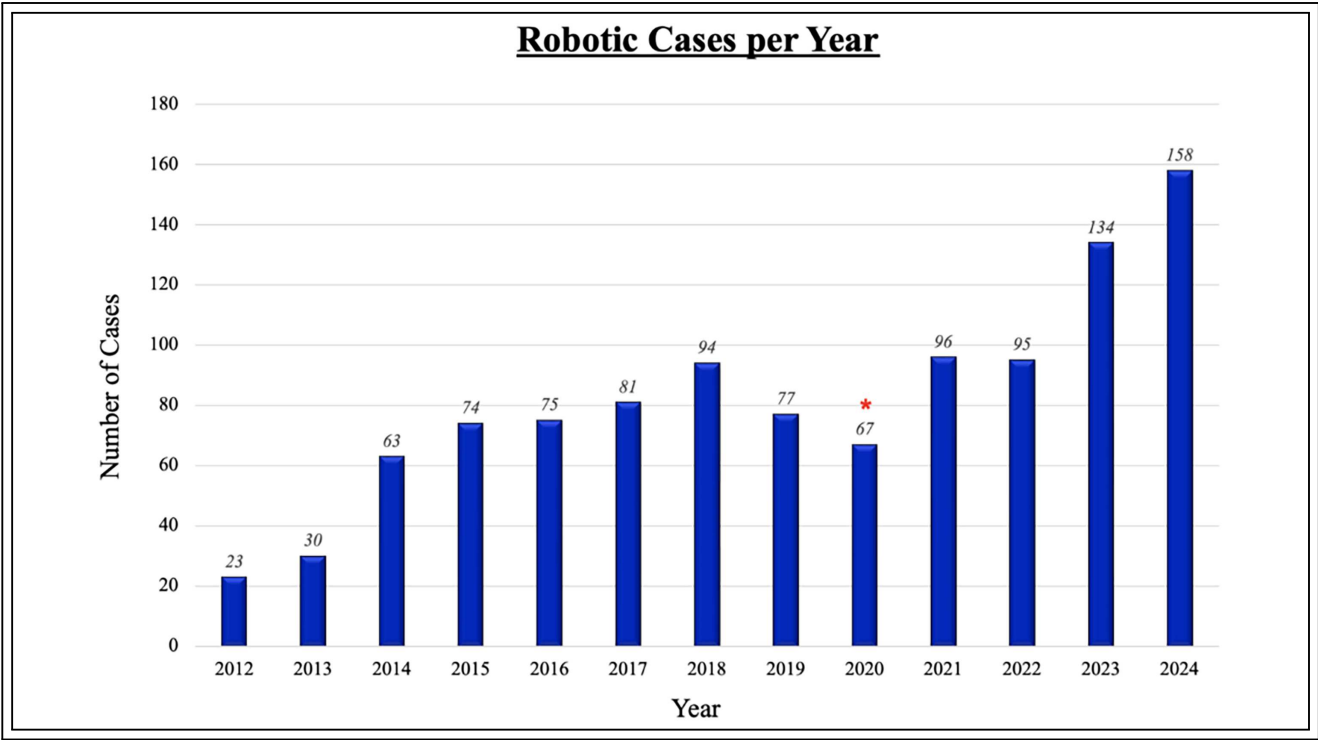


FIGURE 3. Robotic functional and reconstructive urology case volume over time. Note. * denotes COVID-19 pandemic.

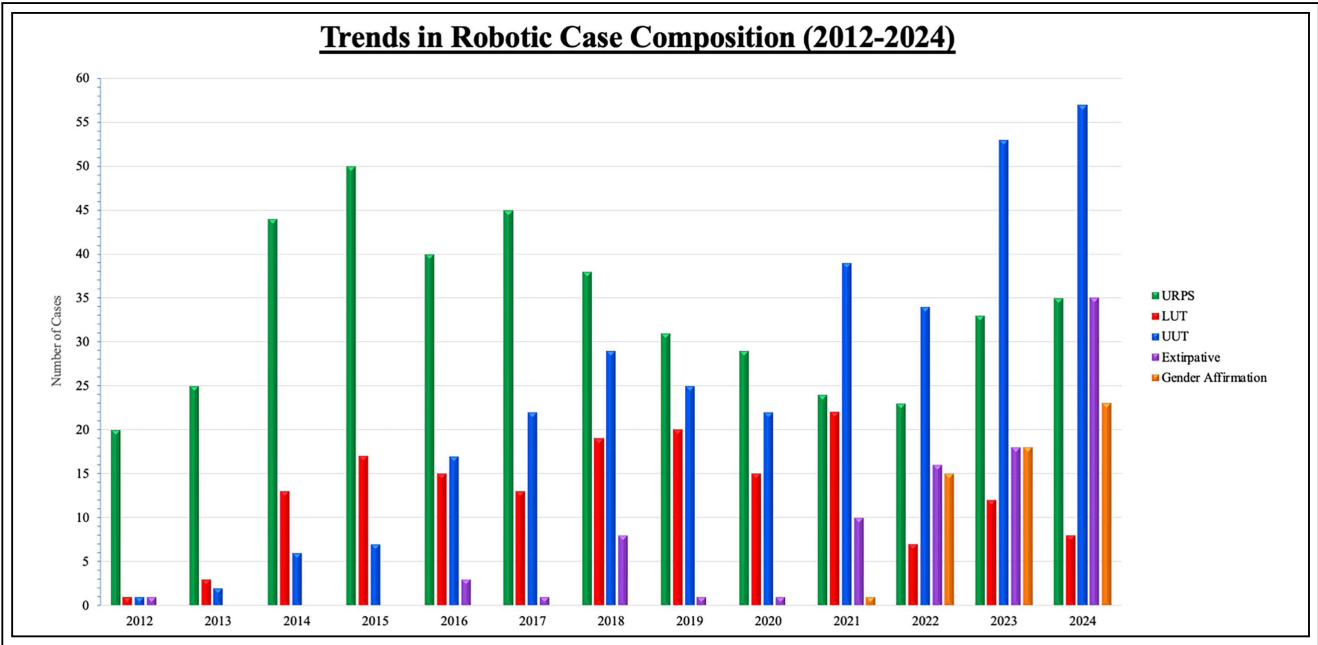


FIGURE 4. Trends in robotic FRU case composition from 2012 to 2024. URPS, urogynecology and reconstructive pelvic surgery; LUT, lower urinary tract reconstruction; UUT, upper urinary tract reconstruction

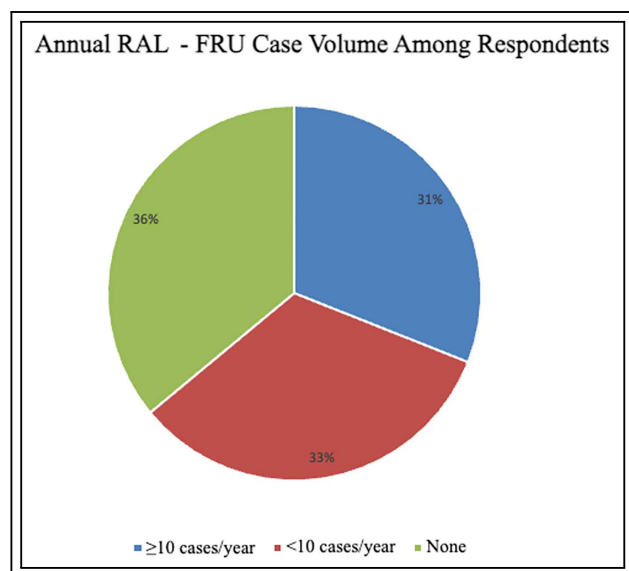


FIGURE 5. Annual robotic-assisted laparoscopic surgery in functional and reconstructive urology (RAL-FRU) case volume among respondents

UUT cases represented an early and sustained area of robotic growth. Additionally, minimally invasive approaches to UUT reconstruction may offer potential downstream benefits such as reduced blood loss, shorter length of stay, and improved postoperative recovery, which may further incentivize robotic utilization. While patient-level outcomes were not assessed in this study, these perceived advantages likely contribute to surgeon preference and thus expanding its use in clinical practice.

While there was a rapid uptake of RAL-FRU surgeries at our institution, over two-thirds of our survey participants performed less than 10 robotic FRU cases per year. This pattern likely reflects the evolving nature of the use of Robotics in FRU. This data also highlights an important limitation as despite our cohort being disproportionately young (59% in practice for less than 10 years), in an academic setting (57%) and having completed a fellowship (54%) when compared to the 2020 American Urological Association (AUA) census (40% academic and 29% fellowship trained) most surgeons still preform small annual volumes.¹⁹ Such limited exposure may not only slow the dissemination of newer robotic FRU techniques but may also contribute to lower surgeon confidence and hesitancy in preforming these procedures routinely without reliable benchmarks for competence. Respondents overwhelmingly desired the development of formalized training case logs

for robotic FRU cases, especially among urologists involved in post-graduate training, suggesting that the lack of their implementation may not be due to a lack of enthusiasm.

Structured repetition and education are crucial in developing a surgeon's skill set, overcoming the learning curve of a given procedure, and ultimately allowing for safe and efficacious incorporation into clinical practice. In 2020, Rice et al. looked at primary outcomes of patient safety, time efficiency and operative outcomes after robotic pancreaticoduodenectomy in 3 groups of surgeons or generations.²⁰ The first generation included those who had received no mentorship or formal curriculum, the second received mentorship but no curriculum, and the third received both mentorship and a curriculum in RAL surgery. Overall operative times, complications higher than Clavien-Dindo grade 2, conversion rates, and estimated blood loss decreased significantly with subsequent generations.²¹ Their results demonstrate a favorable relationship between outcomes and a proficiency-based curriculum coupled with structured mentorship.²⁰ Similarly, Mark Knab et al. highlighted an example of a robotics curriculum for oncology fellows in general surgery that demonstrated an increase in fellow independence during robotic surgeries as well as success in post-fellowship academic careers with high utilization of the RAL platform for pancreaticoduodenectomy.²²

Within the field of urology, similar findings have been demonstrated regarding the benefits of a formalized robotic curriculum. In a prospective cohort study including 272 patients undergoing RARP (robot-assisted radical prostatectomy) by a single surgeon, Sehmbi et al. highlighted improvements in patient outcomes after completion of a formalized robotic surgery curriculum.^{23,24} The curriculum was developed by the European Association of Urology Robotic Urology Section and consisted of online didactic courses, intensive simulation based skills training and supervised modular skills training.²⁴ Their results showed early achievement of published standards in the workforce after completion of a structured RARP curriculum. In a study published in 2020, Beulens et al. demonstrated the efficacy of a robotic surgery training curriculum for residents at their institution.²⁵ They showed improvement in technical skills on various skills challenges on the Da Vinci™ simulator after the structured curriculum and were also provided with more opportunities to use the robot during real patient cases.

Taken together, there is both a desire and need for structured robotic training within urologic residencies and GURS fellowships. Currently, many robotic

FRU cases are being covered by non-reconstructive urologic surgeons to cover the gaps in competency and expertise. While our own institution's experience shows that the RAL platform can be adopted for FRU cases at high volume tertiary centers where volume and repetition allows it, we believe that the adoption of a formalized training curricula and guidelines will help improve future urologist's ability to perform RAL-FRU cases safely and efficiently.

Importantly, while our experience is derived from a high-volume tertiary referral center, we believe these findings are relevant and generalizable beyond such settings. Robotics in FRU is increasingly utilized across both academic and community practices, even if the complexity of cases differs by setting. Community urologists may reasonably limit robotic FRU to less complex procedures, while tertiary centers continue to manage advanced and complex reconstructive cases. Together, these complementary practice patterns likely reflect a maturing robotic ecosystem rather than isolated institutional behavior.

Several limitations warrant consideration. First, our retrospective design and focus on two GURS surgeons at a single institution which limits direct comparison with practice patterns at other centers or within different healthcare systems. Although future studies replicating this analytic framework across multiple institutions, including Canadian centers, would enable national and international comparisons of RAL-FRU adoption, such efforts were beyond the scope of the current study. Our study limits direct comparison with practice patterns at other centers or within different healthcare systems. Although future studies replicating this analytic framework across multiple institutions, including Canadian centers, would enable national and international comparisons of RAL-FRU adoption, such efforts were beyond the scope of the current study. Our study provides only a glimpse into the RAL-FRU case volumes that may differ from national trends or even other high volume institutions. As our aim was to identify changes in practice patterns regarding RAL-FRU surgeries over time, our results only highlight these trends.

We did not aim to analyze patient outcomes or complication rates thus cannot compare robotic FRU surgery to their non-robotic and open approach counterparts. Although we aimed to identify a diverse population of practicing urologists, the REDCap survey was completely voluntary. As such, there is always the potential for response bias with possible tendencies toward those who are more or less enthusiastic about RAL surgery, those who attend urologic conferences, younger surgeons, and those who practice primarily in an academic setting. Due to this,

there was a potential for our respondent population to be skewed toward earlier-career surgeons with relatively low annual RAL-FRU case volumes. This may reflect voluntary response bias utilizing online survey platforms and underrepresentation of the highest-volume national surgeons; however, it may also underscore real-world barriers to RAL-FRU adoption, including limited case exposure, confidence, and proficiency in the absence of standardized training pathways and structured educational resources. Additionally, information related to procedure cost was inaccessible which precluded assessment of the economic impact of RAL-FRU procedures.

This study reflects experience from a high-volume referral center that serves both local patients and individuals traveling across state lines for specialized reconstructive urologic care. Our data-driven analysis demonstrates that adoption of robotic techniques evolved over time both within our own practice and among surveyed colleagues, reflecting broader practice patterns rather than isolated institutional change. Across settings, implementation was shaped by factors including surgeon experience, learning-curve progression, and case selection. By examining institutional experience alongside contemporaneous community practice patterns, this study offers practical insight into how robotic FRU can be integrated in varied clinical environments across various geographical settings. Future studies replicating a similar analytic framework across multiple institutions and healthcare systems could allow for additional comparisons and insight into RAL-FRU adoption across different urologic practice settings.

Conclusion

In conclusion, this study demonstrates a sustained and accelerating adoption of the RAL platform in functional and reconstructive urologic surgeries over the past decade. While early utilization favored RAL-URPS cases within our institution, subsequent growth has been driven predominantly in RAL-UUT reconstruction. Notably, the majority of RAL-FRU procedures performed in the community were completed by urologists without formal GURS fellowship training, underscoring the diffusion of robotic FRU techniques beyond subspecialty centers.

These findings have important implications for surgical training and workforce preparedness. There is clear interest in formalizing robotic FRU education through expansion of GURS case logs to include RAL-FRU procedures and the development of a structured robotic curriculum at the fellowship level.

Aligning training frameworks with evolving practice patterns will be essential to ensure safe adoption, maintain surgical quality, and support the continued growth of robotic reconstructive urology across diverse practice settings.

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Author Contributions

The authors confirm contribution to the paper as follows: Conceptualization, Rohan G. Bhalla and Brian J. Flynn; methodology, Rohan G. Bhalla, Sasha J. Vereecken, Nate Coddington and Brian J. Flynn; software, Rohan G. Bhalla and Sasha J. Vereecken; validation, Rohan G. Bhalla, Sasha J. Vereecken and Nate Coddington; formal analysis, Rohan G. Bhalla; investigation, Rohan G. Bhalla and Nate Coddington; resources, Rohan G. Bhalla, Sasha J. Vereecken and Brian J. Flynn; data curation, Rohan G. Bhalla and Sasha J. Vereecken; writing—original draft preparation, Rohan G. Bhalla and Nate Coddington; writing—review and editing, Rohan G. Bhalla, Sasha J. Vereecken, Ty T. Higuchi and Brian J. Flynn; visualization, Rohan G. Bhalla; supervision, Rohan G. Bhalla, Sasha J. Vereecken, Ty T. Higuchi and Brian J. Flynn; project administration, Rohan G. Bhalla, Sasha J. Vereecken and Brian J. Flynn. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials

Due to the nature of this research, participants of this study did not agree for their data to be shared publicly, so supporting data is not available.

Ethics Approval

This study involved human subjects and was reviewed by the COMIRB. The study was determined

to meet criteria for exempt research under federal regulations and was granted an exempt determination (COMIRB protocol #23-1572). Given the exempt status of the study, the requirement for written informed consent was waived by COMIRB. Participation was voluntary, and completion of the survey was considered to imply informed consent. No identifiable personal health information was collected. All study procedures complied with institutional policies and the principles of the Declaration of Helsinki.

Conflicts of Interest

The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript

RAL	Robotic-assisted laparoscopic
FRU	Functional and reconstructive urology
GURS	Genitourinary reconstructive surgery
LUT	Lower urinary tract
UUT	Upper urinary tract
URPS	Urogynecology and reconstructive pelvic surgery
RARP	Robot-assisted radical prostatectomy

References

1. Zhao CC, Shakir NA, Zhao LC. The emerging role of robotics in upper and lower urinary tract reconstruction. *Curr Opin Urol* 2021;31(5):511–515. doi:10.1097/MOU.0000000000000908.
2. Xu AJ, Mishra K, Lee YS, Zhao LC. Robotic-assisted lower genitourinary tract reconstruction. *Urol Clin North Am* 2022;49(3):507–518. doi:10.1016/j.ucl.2022.05.003.
3. Cho EY, Yang KK, Lee Z, Eun DD. A review of technical progression in the robot-assisted radical prostatectomy. *Transl Androl Urol* 2021;10(5):2171–2177. doi:10.21037/tau.2020.03.17.
4. Ferrari D, Violante T, Novelli M et al. The death of laparoscopy. *Surg Endosc* 2024;38(5):2677–2688. doi:10.1007/s00464-024-10774-2.
5. Ingels A, Bensalah K, Beauval JB et al. Comparison of open and robotic-assisted partial nephrectomy approaches using multicentric data (UroCCR-47 study). *Sci Rep* 2022;12(1):18981. doi:10.1038/s41598-022-22912-8.
6. Parekh DJ, Reis IM, Castle EP et al. Robot-assisted radical cystectomy versus open radical cystectomy in patients with bladder cancer (RAZOR): an open-label, randomised, phase 3, non-inferiority trial. *Lancet Lond Engl* 2018; 391(10139):2525–2536. doi:10.1016/S0140-6736(18)30996-6.

7. Moretti TBC, Magna LA, Reis LO. Surgical results and complications for open, laparoscopic, and robot-assisted radical prostatectomy: a reverse systematic review. *Eur Urol Open Sci* 2022;44:150–161. doi:10.1016/j.euros.2022.08.015.
8. Savun M, Çolakoglu Y, Özdemir H et al. Comparison of open perineal and robot-assisted reconstruction in vesicourethral anastomotic stenosis. *World J Urol* 2025;43(1):413. doi:10.1007/s00345-025-05808-w.
9. Shakir NA, Alsikafi NF, Buesser JF et al. Durable treatment of refractory vesicourethral anastomotic stenosis via robotic-assisted reconstruction: a trauma and urologic reconstructive network of surgeons study. *Eur Urol* 2022;81(2):176–183. doi:10.1016/j.eururo.2021.08.013.
10. Kim S, Buckley JC. Robotic lower urinary tract reconstruction. *Urol Clin North Am* 2021;48(1):103–112. doi:10.1016/j.ucl.2020.09.006.
11. Beal R, Sicilila S, Riestra P, Albala DM. Are robots the future? A case for robotic pyeloplasty as the gold standard treatment in ureteropelvic junction obstruction. *Curr Opin Urol* 2022;32(1):109–115. doi:10.1097/MOU.0000000000000944.
12. Lee Z, Lee M, Koster H et al. A multi-institutional experience with robotic ureteroplasty with buccal mucosa graft: an updated analysis of intermediate-term outcomes. *Urology* 2021;147:306–310. doi:10.1016/j.urology.2020.08.003.
13. Avallone MA, Quach A, Warncke J, Nikolavsky D, Flynn BJ. Robotic-assisted laparoscopic subtrigonal inlay of buccal mucosal graft for treatment of refractory bladder neck contracture. *Urology* 2019;130:209. doi:10.1016/j.urology.2019.02.048.
14. Wyndaele M, Sahai A, Kheir GB et al. What is needed to determine and potentially improve the clinical effectiveness and cost-effectiveness of robot-assisted reconstructive urinary tract and pelvic floor surgery?—ICI-RS 2024. *Neurourol Urodyn* 2025;44(3):683–690. doi:10.1002/nau.25625.
15. Osman NI, Mangir N, Mironska E, Chapple CR. Robotic surgery as applied to functional and reconstructive urology. *Eur Urol Focus* 2019;5(3):322–328. doi:10.1016/j.euf.2019.06.016.
16. Stefanidis D, Huffman EM, Collins JW, Martino MA, Satava RM, Levy JS. Expert consensus recommendations for robotic surgery credentialing. *Ann Surg* 2022;276(1):88–93. doi:10.1097/SLA.0000000000004531.
17. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42(2):377–381. doi:10.1016/j.jbi.2008.08.010.
18. Harris PA, Taylor R, Minor BL et al. The REDCap consortium: building an international community of software partners. *J Biomed Inform* 2019;95:103208. doi:10.1016/j.jbi.2019.10.3208.
19. Census Results—American Urological Association. 2023 [cited 2026 Feb 21]. Available from: <https://www.auanet.org/research-and-data/aua-census/census-results>.
20. Rice MK, Hodges JC, Bellon J et al. Association of mentorship and a formal robotic proficiency skills curriculum with subsequent generations' learning curve and safety for robotic pancreaticoduodenectomy. *JAMA Surg* 2020;155(7):607–615. doi:10.1001/jamasurg.2020.1040.
21. Clavien PA, Barkun J, de Oliveira ML et al. The Clavien-Dindo classification of surgical complications: five-year experience. *Ann Surg* 2009;250(2):187–196. doi:10.1097/SLA.0b013e3181b13ca2.
22. Mark Knab L, Zenati MS, Khodakov A et al. Evolution of a novel robotic training curriculum in a complex general surgical oncology fellowship. *Ann Surg Oncol* 2018;25(12):3445–3452. doi:10.1245/s10434-018-6686-0.
23. Sehmbi AS, Sridhar AN, Sahadevan K et al. Early outcomes of robot-assisted radical prostatectomy following completion of a structured training curriculum: a single surgeon cohort study. *J Clin Urol* 2021;14(4):246–254. doi:10.1177/2051415820938176.
24. Mottrie A, Novara G, van der Poel H, Dasgupta P, Montorsi F, Gandaglia G. The European association of urology robotic training curriculum: an update. *Eur Urol Focus* 2016;2(1):105–108. doi:10.1016/j.euf.2015.09.002.
25. Beulens AJW, Vaartjes L, Tilli S et al. Structured robot-assisted surgery training curriculum for residents in urology and impact on future surgical activity. *J Robot Surg* 2021;15(4):497–510. doi:10.1007/s11701-020-01134-y.