INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

Tele-Robotic Gynaecological Surgeries Using the Indigenous SSI Mantra System: A Case Series

Priya Bhave Chittawar[1], Rahul Gour[2*], Kamal Uddine Zaidi[3], Sonal Jain[4]

[1,3,4]Department of Gynaecological Reproductive Medicine, Her Health Hospital, Bhopal

[2]Department of Research and Development, Her Health Hospital

***Corresponding Author**

DOI: https://doi.org/10.51583/IJLTEMAS.2026.150700065

Received: 26 July 2026; Accepted: 31 July 2026; Published: 12 August 2026

ABSTRACT

Background: Tele-surgery is an emerging field that combines robotics, telecommunications, and digital imaging to overcome geographical barriers in healthcare delivery. In India, where advanced surgical expertise is concentrated in metropolitan areas, tele-robotic surgery may provide improved access to minimally invasive surgical care. This study evaluates the feasibility and safety of long-distance tele-robotic gynaecological surgery using an indigenous robotic platform.

Objective: To assess the technical feasibility, safety, and clinical outcomes of tele-robotic hysterectomy performed using the SSI Mantra 3.0 robotic surgical system.

Methods: A retrospective observational case series was conducted from August to October 2025 at Her Health Hospital, Bhopal. Five patients underwent tele-robotic hysterectomy after ethical approval and informed consent. Procedures were performed using the SSI Mantra 3.0 robotic platform, with remote console operation from geographically separated locations. System performance, communication latency, operative parameters, complications, and postoperative recovery were evaluated.

Results: All five procedures were completed successfully without conversion, intraoperative complications, or technical failure. The mean patient age was 41 ± 4 years. Mean operative time was 124 minutes, docking time was 8 minutes, and estimated blood loss was 41 ± 10 ml. The tele-surgical communication system demonstrated stable performance with average latency of approximately 20 ms and jitter below 10 ms. No connectivity interruption occurred during any procedure. All patients had uncomplicated recovery, with hospital discharge on postoperative day three and no reported postoperative complications.

Conclusion: This preliminary case series demonstrates that long-distance tele-robotic gynaecological surgery using the indigenous SSI Mantra robotic system is feasible and safe. The technology has the potential to expand access to advanced minimally invasive surgery across geographically distant healthcare settings. Larger prospective studies are required to establish broader clinical applicability.

Keywords:- Tele-robotic surgery; Robotic hysterectomy; SSI Mantra 3.0; Indigenous robotic system; Gynecologic surgery; Minimally invasive surgery; Tele-surgery; India.

INTRODUCTION

The convergence of robotics, telecommunications, and advanced imaging has given rise to tele-surgery, a field with the potential to fundamentally reshape healthcare delivery.[1] By enabling surgeons to operate on patients from a distance, tele-surgery offers a powerful solution to geographical barriers, making specialised surgical expertise accessible to underserved and remote populations.[2] This capability is particularly transformative for

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

India, a nation characterised by its vast geography and the concentration of specialist surgeons in urban centres.[3]

The advent of robotic surgery in the 1990 s enabled high-precision remote operations, laying the foundation for telesurgery.[4] Tele-surgery has come a long way from experimental trials to real-world medical breakthroughs. In the early 2000s, researchers showed that long-distance operations were technically possible, even though the technology was still expensive and limited.[5] A major milestone came on September 7, 2001, when Prof. Jacques Marescaux and his team at IRCAD performed the world's first transatlantic robotic surgery. Known as the Lindbergh Operation, it connected a surgeon in New York with a patient in Strasbourg, France, using high-speed fibre-optic networks and advanced robotic tools. This achievement proved that telesurgery wasn't just an idea—it could actually work in practice, opening the door to future medical innovation.[6]

It is now seen as a viable strategy to bridge surgical care gaps by enabling expert surgeons to operate across geographic boundaries without requiring patient transfers.[7] In parallel, robotic surgery has become increasingly prominent in gynaecology, particularly for complex procedures requiring precision and minimally invasive access, and numerous studies have investigated the feasibility and safety of various gynaecologic procedures performed using robotic platforms.[8,9]

However, telesurgery, in which surgeons operate on each other's patients at remote locations, is rarely reported, especially in gynaecology. This case series presents our experience of the first reciprocal gynecologic telesurgeries using an indigenous robotic system in l India. We explore the practical feasibility, clinical safety, and potential applications of this model for surgical care delivery and training over geographically separated sites.

METHODS

A retrospective observational study was conducted from August to October 2025, following approval from the Institutional Ethics Committee (IEC No. SAIMS/IEC/2025/34). Data were collected after written informed consent. Five patients underwent tele-robotic hysterectomy at Her Health Hospital. Informed consent, including permission for robotic and telesurgical intervention, was obtained from all participants

Robotic Platform and Tele surgical Connectivity

The procedures used the SSI Mantra 3.0 robotic platform, a three-arm system with a 3D HD console and wrist instruments. The setup includes a surgeon command centre, patient-side robotic carts, and a vision cart. Key features include modular arms, an open console, head-tracking safety, and reusable instruments. For tele-surgical application, the system incorporates real-time latency monitoring (< 200 ms), dual communication pathways (fibre and satellite backup), and automatic fail-safe protocols that freeze instrument motion if signal quality deteriorates. Safety redundancies allow seamless transition to local console operation within seconds.[10]

In the event of a connectivity failure, the bedside surgeon was pre-designated to immediately assume control, with local consoles kept active to permit uninterrupted continuation of surgery. The tele-surgical setup utilised a dedicated high-speed data connection to establish real-time communication between the console located at SSI headquarters in Gurgaon and the operating room. A skilled team of bedside surgeons at the Hospital and Robotics operating room handled patient-side tasks, including trocar placement, robotic docking, and instrument exchange. The three tele surgeries were performed with the patient cart stationed at HER Health Hospital, and in once surgery the patient cart stationed at Dr Kamlesh Tondon Hospital, Agra (550 km away), while the robotic consoles were operated remotely one case from SSI office Delhi (700 km away), two cases of complex hysterectomy were remotely performed from a "Mantra-M Bus," a mobile robotic surgery unit. The patient was located at the HER Health Hospital in Bhopal. **(Figure: -1)**

As we can see **in Figure 2, the standard** port configuration for tele-surgery using the indigenous robotic system. 3 robotic instrument ports are positioned in a fan-shaped arrangement across the upper abdomen, with one non-robotic assistant port for stapler firing, suction, and specimen handling. The optical trocar is centrally placed to provide optimal visualisation.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

Figure 1: Tele-Robotic Gynaecology Surgery – Communication Flow from Bhopal to Delhi and Agra

Figure 2: Standard Port Configuration for Robotic Telesurgical Hysterectomy Using the SSI Mantra Robotic System 3.0

Figure 3: Telesurgical Rrobotic Hysterectomy using the SSI Mantra Ssystem 3.0, showing remote console operation via Mantra Mobile Bus, the operating-room setup with the robotic platform at Her Health Hospital in Bhopal, Central India, Intra- operative Multiple Uterine Fibroids with Adhesions

Surgical Technique:

The patient was placed in the lithotomy position with Trendelenburg orientation under general anaesthesia. Pneumoperitoneum was created, and three robotic ports, along with one assistant non-robotic port, were inserted. After docking, the pelvis was inspected. Robotic Instruments used included a fenestrated bipolar grasper and monopolar curved scissors.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

Bilateral round ligaments, tubes, and tube-ovarian ligaments were coagulated and divided. The uterovesical fold was opened, and the uterine arteries were coagulated. The bladder was pushed down to expose the vaginal wall. The uterosacral and cardinal ligaments were divided, and the uterus with cervix was removed. Salpingectomy or salpingo-oophorectomy was performed as indicated. The patient tolerated the procedure well and was transferred to recovery in stable condition.

RESULTS

All five tele-surgical robotic procedures were completed successfully. The robotic system functioned reliably, with no technical problems or noticeable latency. The tele-surgical connection remained stable throughout all operations, confirming the feasibility of high-speed, data-based tele-surgery for real-time gynaecological procedures.

Patient Demographics and Operative Details

Five patients were included in the study. Their average age was 41 ± 4 years. All patients were female, with a mean body weight of 50 ± 4 kg and a BMI between 20 and 25 **(Table 1).**

Table 1: Patient characteristic and surgical procedure

Case	Age	BMI	Diagnosis	Procedure
1	45	24.4	Uterine Fibroid	Tele Robotic Hysterectomy
2	44	24.9	Fibroid Uterus	Tele Robotic Hysterectomy
3	39	21.3	Abnormal Uterine Bleeding	Tele Robotic Hysterectomy
4	45	19.3	Uterine Fibroid	Tele Robotic Hysterectomy
5	35	24.5	Endometriosis	Tele Robotic Hysterectomy

The mean operative time was 124 minutes. Docking time averaged 8 minutes, and console time was 99 ± 20 minutes. The mean suturing time was 16 minutes. Estimated blood loss was 41 ± 10 ml. The average hospital stay was 3 days. **(Table -2)**

Table 2: Surgical outcomes of Tele Robotic Surgery Cases

Case	Total op time (min)	Docking time (min)	Console time (min)	Post-op hospital stays (day)	Vault Suturing time (min)	EBL (mL)	Complication
1	125	08:00	75	3	20	50	No
2	137	08:00	137	2	15	30	No
3	99	07:00	99	2	15	55	No
4	125	07:00	90	3	18	30	No
5	135	08:00	95	2	12	40	No

All procedures were completed without intraoperative complications, conversion, or the need for additional ports.

Technical Performance

The technical setup provided a safe and stable telesurgery environment. Secure communication using UDP, TCP, WebRTC, and TLS 1.3 enabled real-time, high-quality video and precise instrument control. The average latency was 20 ms, with jitter under 10 ms, and no connections were lost. These parameters were monitored continuously during each case. A video-conferencing system enabled communication between the two sites. **(Table-3)**

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

Table:-3 Network and Connectivity Architecture for Tele-Robotic Surgery: Summary of Key Performance Parameters

Network Values	
Parametrs	Value
Network Bandwidth	50 Mbps
Network Type	P2P MPLS, Layer VPN
One- way Latency	30-30 ms
Round-trip Latency	250- 260 ms
Video Codec	HEVS (H.265)
Encoding Mode	Ultra- Low Latency (ULL)
Video Latency	50-60 ms
Encryption	IPsec, AES 256 - bit
Maximum Bit Rate	25 Mbps
Packet Loss rate	< 0.10%

The on-site team only provided routine bedside assistance. A dual-console system was active throughout the procedure to allow immediate takeover if necessary. All patients were discharged on postoperative day 3, and no complications were reported at follow-up.

Staff and Patient Experience

Operating room staff reported that the tele-surgical workflow was comparable to standard on-site surgery. Patients did not report increased anxiety compared with traditional procedures.

Postoperative Recovery and Discharge

All patients were mobilised on the day of surgery and began an oral liquid diet, followed by a soft diet, on postoperative day 1. The hospital stay was 3 days. No cases of anastomotic leak, bleeding, surgical-site infection, or delayed recovery were observed. Pain was adequately controlled, and all patients resumed normal physical activity within a few days after discharge.

DISCUSSION

This study demonstrates the first successful long-distance tele-robotic gynecologic surgeries in India using the indigenously developed SSI Mantra robotic platform. All procedures were completed without intraoperative complications, connectivity issues, or conversions, confirming both the clinical feasibility and technological reliability of telesurgery over distances of 550–700 km. These results are consistent with earlier milestones in remote surgery, including the Lindbergh operation, which first established the concept of tele-surgery despite significant latency and technological constraints.[11] In contrast, the low latency and stable video transmission achieved in this study reflect substantial improvements in India's digital infrastructure, enabling real-time surgical performance comparable to conventional on-site robotics.[12,13]

Clinical outcomes further support the safety of this approach. Operative duration, blood loss, and postoperative recovery were similar to previously reported values for standard robotic hysterectomy and pelvic floor surgery.[14] Early mobilisation, early dietary intake, and the absence of postoperative complications are in alignment with evidence demonstrating the ergonomic precision and clinical benefits of robotic platforms in gynaecology.[15,16]

Importantly, tele-robotic surgery has the potential to significantly reduce geographic disparities in access to advanced minimally invasive care. In India, specialist gynecologic surgeons are predominantly concentrated in metropolitan centres, leaving rural and semi-urban hospitals underserved. The reciprocal tele-surgery model described in this study, where surgeons at distant sites operate on each other's patients, provides a new

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

framework for collaborative care, remote guidance, and multi-site clinical support. Similar models have been explored internationally, but this represents the first documented experience in gynaecology using a fully indigenous system.

The ability of the SSI Mantra platform to operate reliably from both fixed command centres and mobile surgical units adds versatility, expanding its potential applications to remote regions, disaster settings, and military environments. Together, these findings offer early evidence that long-distance tele-robotic gynecologic surgery can be safe, reliable, and scalable within India's healthcare ecosystem.

CONCLUSION

This preliminary case series demonstrates the feasibility of long-distance tele-robotic gynecologic surgery using an indigenous robotic platform. All procedures were successfully completed with stable system performance and favourable short-term outcomes, without intraoperative complications or technical disruptions.

While these findings are encouraging, larger prospective studies are required to establish the safety, efficacy, cost-effectiveness, and broader clinical applicability of tele-robotic surgery before its integration into standard gynecologic practice.

Data Availability: - No datasets were generated or analysed during the current study.

Declarations: - Competing interests: The authors declare no competing interests.

Acknowledgement: The authors acknowledge the use of the SSI Mantra robotic system developed by SS Innovations and thank the operating theatre staff for their support.

REFERENCE

1. [1] Marescaux J, Leroy J, Rubino F, Smith M, Vix M, Simone M, Mutter D. Transcontinental robot-assisted remote telesurgery: feasibility and potential applications. Ann Surg. 2002 Apr;235(4):487-92. doi: 10.1097/00000658-200204000-00005. PMID: 11923603; PMCID: PMC1422462.
2. [2] Anvari M. Telesurgery: remote knowledge translation in clinical surgery. World J Surg. 2007 Aug;31(8):1545-50. doi: 10.1007/s00268-007-9076-5. Epub 2007 May 30. PMID: 17534550.
3. [3] Marescaux J, Rubino F. Telesurgery, telementoring, virtual surgery, and telerobotics. Curr Urol Rep. 2003 Apr;4(2):109-13. doi: 10.1007/s11934-003-0036-9. PMID: 12648426.
4. [4] Reddy K, Gharde P, Tayade H, et al. Advancements in robotic surgery: a comprehensive overview of current utilizations and upcoming frontiers. Cureus. 2023;15(12):e50415. https:// doi. org/ 10. 7759/ cureus. 50415.
5. [5] Marescaux, J., Leroy, J., Rubino, F., Vix, M., Simone, M., Mutter, D. "Transcontinental Robot-Assisted Remote Telesurgery: Feasibility and Potential Applications." Annals of Surgery. Vol. 235, No. 4 (2002): 487–492
6. [6] Jacques Marescaux, Leroy J., Rubino F., Vix M., Simone M., Mutter D. "Transcontinental Robot-Assisted Remote Telesurgery: Feasibility and Potential Applications." Annals of Surgery, Vol. 235, No. 4, 2002: 487–492.
7. [7] Pazzaglia E, Pasquini P, Jamaer E, Traen K, Despierre E, Mottrie A. Pioneering telesurgery in gynecology: the first European case of total hysterectomy. J Robot Surg. 2025 Aug 8;19(1):460. doi: 10.1007/s11701-025-02638-1. PMID: 40779084; PMCID: PMC12334479.
8. [8] Pazzaglia E, Pasquini P, Jamaer E, Traen K, Despierre E, Mottrie A. Pioneering telesurgery in gynecology: the first European case of total hysterectomy. J Robot Surg. 2025 Aug 8;19(1):460. doi: 10.1007/s11701-025-02638-1. PMID: 40779084; PMCID: PMC12334479.
9. [9] Sinha R, Bana R, Sanjay M: Comparison of robotic and laparoscopic hysterectomy for the large uterus. JSLS.2019, 23:e2018. 10.4293/JSLS.2018.0006

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XV, Issue VII, July 2026

10. [10] SSI Mantra Robotic Surgical System. [Internet]. Gurgaon (India): SS Innovations International Inc.; [cited 2025 Jul 10]. Available from: https://ssinnovations.com/
11. [11] Marescaux J, Leroy J, Gagner M, Rubino F, Mutter D, Vix M, Butner SE, Smith MK. Transatlantic robot-assisted telesurgery. Nature. 2001 Sep 27;413(6854):379-80. doi: 10.1038/35096636. Erratum in: Nature 2001 Dec 13;414(6865):710. PMID: 11574874.
12. [12] Motiwala ZY, Desai A, Bisht R, Lathkar S, Misra S, Carbin DD. Telesurgery: current status and strategies for latency reduction. J Robot Surg. 2025 Apr 12;19(1):153. doi: 10.1007/s11701-025-02333-1. PMID: 40220039.
13. [13] Borahay MA, Tapısız ÖL, Alanbay İ, Kılıç GS. Outcomes of robotic, laparoscopic, and open hysterectomy for benign conditions in obese patients. J Turk Ger Gynecol Assoc. 2018 Jun 4;19(2):72-77. doi: 10.4274/jtgga.2018.0018. Epub 2018 Apr 27. PMID: 29699956; PMCID: PMC5994808.
14. [14] Sinha R, Sanjay M, Rupa B, Kumari S. Robotic surgery in gynecology. J Minim Access Surg. 2015 Jan-Mar;11(1):50-9. doi: 10.4103/0972-9941.147690. PMID: 25598600; PMCID: PMC4290120.
15. [15] Nobbenhuis MAE, Gul N, Barton-Smith P, O'Sullivan O, Moss E, Ind TEJ; Royal College of Obstetricians and Gynaecologists. Robotic surgery in gynaecology: Scientific Impact Paper No. 71 (July 2022). BJOG. 2023 Jan;130(1):e1-e8. doi: 10.1111/1471-0528.17242. Epub 2022 Jul 17. PMID: 35844092.
16. [16] Sinha R, Sanjay M, Rupa B, Kumari S. Robotic surgery in gynecology. J Minim Access Surg. 2015 Jan-Mar;11(1):50-9. doi: 10.4103/0972-9941.147690. PMID: 25598600; PMCID: PMC4290120.