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# Minimally Invasive Nipple-Sparing Mastectomy: Early Experience With Endoscopic and Robotic Techniques

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## ABSTRACT

**Objective:** Minimally invasive nipple-sparing mastectomy (NSM), performed via endoscopic or robotic-assisted approaches, has been developed to improve cosmetic and psychosocial outcomes without compromising oncologic safety. While international experience is growing, data from low- and middle-income countries remain limited.

**Materials and Methods:** We conducted a retrospective case series of five consecutive patients (six breasts) who underwent minimally invasive NSM between January 2024 and June 2025 in an Indian center. Three patients underwent conventional endoscopic NSM and two underwent robotic-assisted NSM (one unilateral and one bilateral). Data collected included demographic and genetic status, tumor biology, operative details, reconstruction method, perioperative complications, pathology, and short-term follow-up. Primary endpoints were feasibility and safety; secondary endpoints were margin status, early oncologic outcomes, and cosmetic satisfaction.

**Results:** All procedures were completed successfully without conversion to open surgery. Median (range) operative time was 210 (180–300) minutes, with robotic procedures requiring longer duration. No intraoperative complications, nipple-areolar necrosis, or implant losses were observed. Two patients developed minor seromas that resolved with aspiration. Pathological margins were negative in all cases. At a median follow-up of six (4–18) months, all patients were alive, disease-free, and reported good-to-excellent cosmetic satisfaction.

**Conclusion:** Our early experience demonstrates that both endoscopic and robotic-assisted NSM are feasible and safe in carefully selected patients, providing satisfactory oncologic and esthetic outcomes. However, these results should be interpreted with caution due to the very small sample size, short follow-up, and absence of a comparator group. Larger prospective multicenter studies with long-term outcomes are required to confirm oncologic safety and define the role of minimally invasive NSM India.

**Keywords:** Endoscopic mastectomy; robotic mastectomy; nipple-sparing mastectomy; breast cancer; minimally invasive surgery; reconstruction; India

## KEY POINTS

- First report of MI NSM from India.
- Feasible with minimal complications.

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## Introduction

Breast cancer remains the most common malignancy in women worldwide, and surgical treatment has evolved substantially over the last decades (1, 2). While mastectomy continues to be an essential option for many patients, advances in technique have sought to balance oncologic safety with cosmetic and psychosocial outcomes. Nipple-sparing mastectomy (NSM) represents one such innovation, offering preservation of the nipple–areolar complex without compromising local control when carefully selected criteria are applied (3-6). However, conventional NSM performed through visible breast incisions can be associated with compromised esthetics, sensory loss, and in some cases, ischemic complications of the nipple-areolar complex (7). These limitations have driven the development of minimally invasive approaches, such as endoscopic and robotic-assisted NSM, which relocate incisions to the axilla or lateral chest wall, thereby concealing scars and potentially reducing flap ischemia (8-10).

Recent systematic reviews and meta-analyses have confirmed that endoscopic NSM achieves oncological outcomes comparable to conventional NSM, with the added advantages of higher patient satisfaction and lower necrosis rates when single-incision techniques are used (11, 12). Robotic-assisted NSM has further expanded minimally invasive options by providing enhanced visualization and instrument dexterity, although at the expense of longer operative times and increased costs (13, 14). Despite these advances, published experience with minimally invasive NSM remains limited, particularly in low- and middle-income country settings where adoption has been slower. In this report, we present our initial institutional experience with both endoscopic and robotic-assisted NSM in an Indian center, focusing on perioperative safety, pathological adequacy, and short-term patient outcomes.

## Materials and Methods

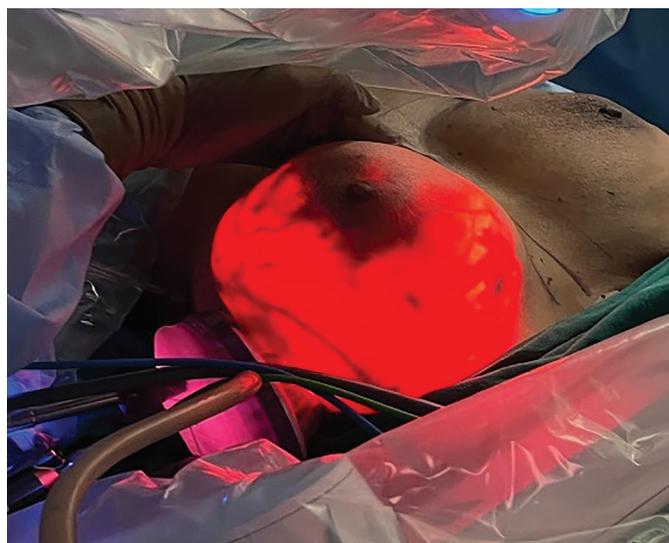
This is a retrospective case series of six consecutive patients who underwent minimally invasive NSM between June 2024 and June 2025. Four patients underwent conventional endoscopic NSM and two underwent robotic-assisted NSM (one unilateral and one bilateral). Ethics committee approval was obtained from Institute Ethics Committee Netaji Subhash Chandra Bose Medical College Jabalpur (approval number: IEC/2025/8988, date: 03.09.2025).

**Patient selection:** Patients were included if they had early breast cancer or *BRCA1* mutation warranting risk-reducing mastectomy, with tumor-to-nipple distance >2 cm and no radiological or clinical evidence of nipple-areolar complex involvement. Contraindications included inflammatory breast cancer, extensive skin involvement, or contraindications to general anesthesia.

**Preoperative assessment:** All patients underwent clinical evaluation, digital mammography, and/or breast magnetic resonance imaging or positron emission tomography-computed tomography as indicated. *BRCA1* mutation was confirmed in two patients. Neoadjuvant chemotherapy was administered in one patient with locally advanced triple-negative breast cancer.

**Surgical technique:** For conventional endoscopic NSM, an axillary incision was used with CO<sub>2</sub> insufflation to create a working space. Endoscopic dissection was carried out to excise the glandular tissue while preserving the skin envelope and nipple-areolar complex. In both approaches, a GelPOINT® or Regisport® device was inserted through a single axillary or anterior axillary incision, creating the operating window (Figure 1). CO<sub>2</sub> insufflation at a pressure of 8–10 mmHg was maintained throughout the dissection to establish the working space. Procedures began with lateral breast dissection, progressing towards the nipple-areolar complex, followed by medial, superior, and inferior flap creation. The gland was then separated from the pectoral fascia and removed *en bloc*. Reconstruction was performed using either implant-based techniques with mesh reinforcement or autologous options, depending on patient preference and oncologic considerations (Figure 2).

**Reconstruction:** Five patients underwent immediate implant-based reconstruction with TiLOOP mesh placement. Implant size was chosen based on preoperative breast volume and intraoperative assessment. One patient opted for delayed reconstruction (Figure 3). All five reconstructions were performed using a pre-pectoral, single-plane implant pocket following endoscopic or robotic-NSM. Pocket selection was based on: Flap integrity and thickness, assessed intraoperatively by surgeon palpation and optical evaluation; indocyanine green angiography-assisted perfusion assessment (used in two cases);



**Figure 1.** Robotic assisted dissection through GelPOINT® ports

and absence of prior radiation or significant comorbidities affecting vascularity (Figure 4). Pocket stabilization was achieved using TiLoop® mesh fixation along the lateral border, facilitating anatomical contour restoration and preventing implant migration. The implant-mesh construct was completely wrapped (total anterior coverage) after pre-soaking in antibiotic saline. The assembly was inserted through the 3–4 cm working incision using a lateral-to-lateral push technique optimized for minimally invasive access. Fixation was performed using interrupted PDS 3–0 sutures, securing the mesh laterally to prevent postoperative displacement and to recreate natural ptosis. No intraoperative mesh folding or bunching occurred. All implants were round, moderate-profile, smooth-surface silicone gel implants either a Motiva Round SilkSurface® Plus silicone breast implant (Establishment Labs S.A., Alajuela, Costa Rica)

or a Silimed silicone gel breast implant (Silimed Indústria de Implantes Ltda., Rio de Janeiro, Brazil; distributed in India by Technomed India Pvt. Ltd., New Delhi, India).

**Postoperative care and follow-up:** Patients received standardized analgesia and drain management. A single 14F vacuum closed-suction drain was placed in the pre-pectoral/periprosthetic plane in all cases. Drain removal criteria was when output was <30 mL/24 hours. Patients were discharged on postoperative day 2 if stable. Follow-up was scheduled for 2 weeks, 1 month, 3 months, and 6 months, including clinical examination and, where indicated, imaging.

**Outcomes:** Primary endpoints were operative feasibility, perioperative complications (bleeding, seroma, infection, skin/nipple necrosis, implant loss), and length of stay. Secondary endpoints were margin status, early oncologic outcomes, and patient-reported cosmetic satisfaction (graded on a five-point Likert scale). Given the very small sample size and the purely descriptive intent of this early feasibility case series, no inferential statistical analyses were performed. Continuous variables were summarized using median and range, and categorical variables using counts and proportions. These descriptive calculations were performed using standard spreadsheet software.



**Figure 2.** Immediate postoperative image after implant placement

## Results

Six patients (eight breasts) underwent minimally invasive NSM with a median (range) age of 39.5 (33–45) years. Five



**Figure 3.** Outcomes of left robotic NSM, (A) Pre-operative front view, black mark on right side is previous scar of BCS, (B) Pre-operative lateral view, (C) Post-operative 6 months front view, (D) Post-operative 6 months lateral view

NSM: Nipple-sparing mastectomy; BCS: Breast-conserving surgery

patients were *BRCA* mutation carriers, and one had sporadic breast carcinoma. Four procedures were performed using a conventional endoscopic technique and four using a robotic-assisted approach (one unilateral, one bilateral) (Table 1).

**Operative details:** All procedures were completed successfully without conversion to open surgery. The median operative time was 210 (180–300) minutes, with robotic procedures taking longer than conventional endoscopic cases. Estimated blood loss was minimal (<100 mL in all patients). Five patients underwent immediate implant-based reconstruction with TiLOOP mesh placement ( $n = 3$ ) or prolene mesh ( $n = 2$ ). Axillary surgery was performed as described above.

**Pathological findings:** All resection specimens had negative surgical margins. One patient who received neoadjuvant chemotherapy for locally advanced triple-negative breast cancer achieved a complete pathological response with no residual invasive carcinoma in the breast or axillary lymph nodes. The remaining cases included invasive ductal carcinoma with or without associated ductal carcinoma *in situ*. No occult nipple involvement was detected in any case.

**Postoperative outcomes:** Median hospital stay was 2 (2–3) days. There were no intraoperative complications, or nipple-areolar necrosis, implant loss, or re-explorations. Three patients had partial skin flap necrosis and were managed conservatively. Median indwelling time of drainage catheters was 5–7 postoperative days. Two patients developed minor seromas that resolved with aspiration. No surgical

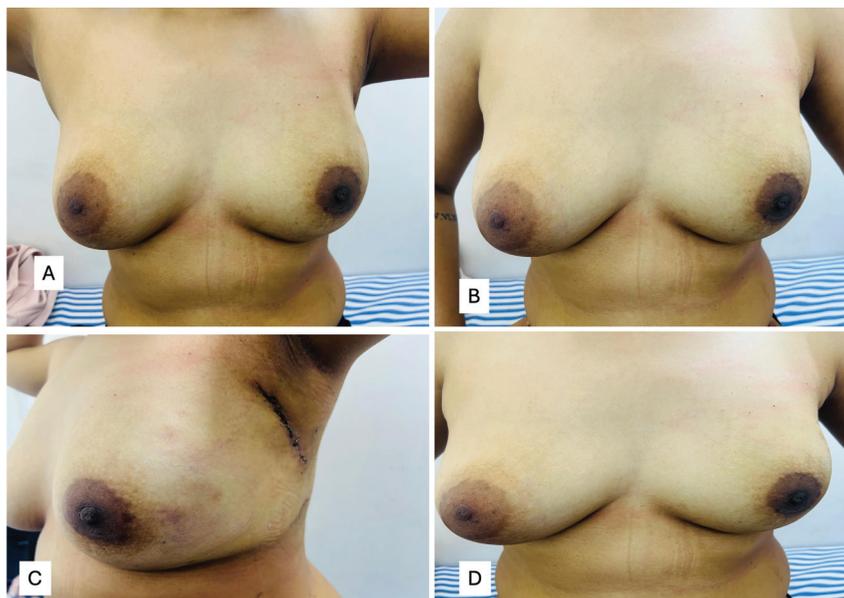
site infections occurred. Two patients received adjuvant radiotherapy (VMAT, 50 Gy/25 fractions targeting chest wall and supraclavicular fossa). Patients receiving post-mastectomy radiotherapy demonstrated acceptable early cosmetic and oncologic outcomes, with no mesh exposure or implant complications.

**Follow-up:** At a median follow-up of four (2–12) months, all patients were alive and disease-free. The five *BRCA1*-positive patients remained recurrence-free. Patient-reported cosmetic satisfaction was high in all cases, with all patients rating their cosmetic outcome as “good” or “excellent.” Preservation of nipple-areolar sensation was partial in five breasts and absent in the other three.

## Discussion and Conclusion

Our early adoption of both approaches, including the first reported robotic NSM with TiLoop® mesh reconstruction for a *BRCA*-positive patient in India, highlights their feasibility and applicability in our national context. Our experience supports international evidence that these minimally invasive procedures can be safely performed with favorable short-term oncologic and esthetic outcomes when applied to selected patients. Importantly, these outcomes mirror those reported in high-volume centers internationally, despite our series representing the initial learning curve for the technique.

The wider literature increasingly supports the oncologic safety of minimally invasive NSM (13, 15). Our series is consistent with



**Figure 4.** Outcomes of left endoscopic NSM, (A&B) Pre-operative front views, (C) Post-operative immediate view, (D) Post-operative 4 months view

NSM: Nipple-sparing mastectomy

**Table 1. Baseline characteristics, operative details, and outcomes of patients undergoing minimally invasive nipple-sparing mastectomy**

Case	Age (years)	Genetic status	Histology	Procedure	Axillary procedure	Reconstruction	Op time (min)	Drainage duration (days)	Hospital stay (days)	Complications	Follow-up (months)	Status
1	42	BRCA1+	IDC, TNBC, multifocal	Unilateral robotic NSM (left)	Prior axillary clearance	Pre-pectoral, smooth-surface silicone gel Implant + TiLOOP mesh anterior coverage	240	5 days	2	None	6	NED
2	33	BRCA1+	IDC, TNBC, LABC	Bilateral robotic NSM	ALND (right)	Pre-pectoral, smooth-surface silicone gel Implant + TiLOOP mesh anterior coverage	300	10 days	2	None	4	NED
3	36	BRCA1+	IDC, TNBC	Endoscopic NSM	SLNB	Pre-pectoral, smooth-surface silicone gel Implant + TiLOOP mesh anterior coverage	200	6 days	2	Partial skin flap necrosis	4	NED
4	45	BRCA1+	IDC, ER+	Endoscopic NSM	SLNB	Pre-pectoral, smooth-surface silicone gel Implant + TiLOOP mesh anterior coverage	250	5 days	3	Seroma	2	NED
5	37	Negative	IDC, TNBC	Endoscopic NSM	SLNB	Planned for delayed reconstruction	200	4 days	5	Seroma and Partial skin flap necrosis	12 months	NED
6	45	BRCA1 +	IDC, TNBC	B/L Endoscopic	SLNB	Pre-pectoral, smooth-surface silicone gel Implant + TiLOOP mesh anterior coverage	350	7 days	2	Superficial necrosis	2 months	NED

IDC: Invasive ductal carcinoma; TNBC: Triple-negative breast cancer; ER+: Estrogen receptor positive; NSM: Nipple-sparing mastectomy; ALND: Axillary lymph node dissection; SLNB: Sentinel lymph node biopsy; B/L: Bilateral; BRCA1+: BRCA1 mutation positive; NED: No evidence of disease; min: Minutes

these findings, with robotic cases requiring more operative time but achieving excellent cosmesis and early recovery (16-20). The absence of major ischemic complications in our small cohort may reflect careful patient selection, avoidance of periareolar incisions, and the use of mesh-supported immediate reconstruction.

From a health systems perspective, the integration of robotic NSM into a low- and middle-income country setting has several limitations. Challenges remain huge, including access to robotic platforms, and cost considerations that may limit widespread adoption. However, these techniques respond to increasing patient demand for less visible scarring and breast preservation, aligning oncologic surgery with quality-of-life goals. Hence, careful adoption of endoscopic NSM innovations may be implemented, even in resource-constrained environments as has been demonstrated for other surgeries (20).

Our results highlight the importance of careful patient selection for minimally invasive NSM. Ideal candidates in our early experience were those with early-stage tumors, tumor-to-nipple distance greater than 2 cm, no radiological or intraoperative evidence of nipple-areolar involvement, and patients undergoing risk-reducing surgery for *BRCA1* mutation. These strict criteria likely contributed to the absence of major complications in our series.

### Study Limitations

Our study has limitations inherent to a small, retrospective series, including short follow-up and absence of a comparator group. Longer-term oncologic outcomes, impact on nipple sensation, and durability of reconstruction could not be fully assessed. Despite small sample size, by reporting our initial experience, we contribute real-world evidence from a resource-limited context where published data are scarce. These early results support the feasibility of establishing minimally invasive NSM programs beyond high-income centers and provide a foundation for larger prospective studies to refine patient selection, optimize technique, and confirm long-term safety. However, robotic mastectomy is not economically feasible for widespread adoption in many low- and middle income countries. Our experience represents a selective, early institutional effort supported through existing infrastructure, not routine practice. TiLoop® mesh and robotic platforms have cost implications and our results should be interpreted as proof-of-concept, not as an endorsement for broad application.

Our early experience with endoscopic and robotic-assisted NSM demonstrated that these approaches are technically feasible and can be performed safely in carefully selected patients. Short-term outcomes in terms of oncologic adequacy, complication rates, and cosmetic satisfaction were favorable and consistent with international reports. However, given the small sample size, short duration of follow-up, and absence of a comparator group, these findings should be interpreted with caution. Larger prospective studies with long-term follow-up are needed to validate oncologic safety, assess durability of reconstruction, and define the cost-effectiveness of minimally invasive mastectomy in the Indian context.

### Ethics

**Ethics Committee Approval:** Ethics committee approval was obtained from Institute Ethics Committee Netaji Subhash Chandra Bose Medical College Jabalpur (approval number: IEC/2025/8988, date: 03.09.2025).

**Informed Consent:** Retrospective study.

### Footnotes

### Authorship Contributions

Concept: S.M.B., S.K.Y., R.G., J.T., S.C.; Design: S.M.B., S.K.Y., R.G., J.T., S.C.; Data Collection or Processing: S.M.B., S.K.Y., R.G., J.T., S.C.; Analysis or Interpretation: S.M.B., S.K.Y., R.G., J.T., S.C.; Literature Search: S.M.B., S.K.Y., R.G., J.T., S.C.; Writing: S.M.B., S.K.Y., R.G., J.T., S.C.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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