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RESEARCH ARTICLE
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SURGICAL INTERVENTIONS FOR ENDOMETRIOSIS: LONG-TERM OUTCOMES AND RECURRENCE RATES

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ABSTRACT

Background: Endometriosis affects up to 10 % of women of reproductive age; long-term data comparing contemporary surgical approaches remain limited.

Objective: To evaluate ten-year pain relief, recurrence, fertility, quality of life, and re-operation rates after laparoscopic conservative excision, laparoscopic ablation/fulguration, and definitive total hysterectomy with bilateral salpingo-oophorectomy (TH-BSO).

Methods: In a multicentre prospective cohort we followed 948 consecutively enrolled women for ≥10 years. Participants were assigned to excision (n = 318), ablation (n = 316), or TH-BSO (n = 314) according to planned surgery. Primary outcome was symptomatic recurrence (pelvic pain ≥ 40 mm on a 100-mm visual-analogue scale persisting ≥3 months). Secondary outcomes included imaging-confirmed relapse, spontaneous pregnancy within 24 months, EHP-30 quality-of-life scores, and re-operation-free survival. Kaplan–Meier methods and multivariable Cox models (robust variance for centre clustering) estimated time-to-event outcomes and independent predictors.

Results: Baseline characteristics were comparable between excision and ablation cohorts (mean age ≈ 32 y; stage III/IV disease ≈ 66 %). TH-BSO patients were older (38 ± 5 y) and more advanced (stage III/IV = 93 %). At 12 months median pain fell by 48 mm after excision, 38 mm after ablation, and 65 mm after TH-BSO. Ten-year symptomatic recurrence was 33.0 % for excision, 56.3 % for ablation, and 8.3 % for TH-BSO; corresponding imaging relapse rates were 28.9 %, 47.1 %, and 4.8 %. Spontaneous pregnancy occurred in 61.7 % of excision versus 43.6 % of ablation patients desiring fertility. Major 30-day complications were ≤3.5 % across groups. Independent predictors of recurrence were incomplete excision (adjusted HR 2.3), stage IV disease (HR 1.8), and smoking (HR 1.5), whereas continuous hormonal suppression was protective (HR 0.6).

Conclusions: Surgical radicality dictated long-term success. TH-BSO offered the most durable pain relief with minimal recurrence but eliminated fertility. Laparoscopic excision achieved superior durability and fertility outcomes compared with ablation, with acceptable morbidity. Ablation should be reserved for carefully selected low-burden cases or resource-limited settings; all patients benefit from postoperative hormonal suppression and lifestyle optimisation.

Keywords: Endometriosis; Laparoscopic excision; Hysterectomy; Recurrence; Fertility.

INTRODUCTION

Endometriosis is a chronic gynecological disorder characterized by the presence of endometrial-like tissue outside the uterus, often leading to debilitating pelvic pain, dysmenorrhea, dyspareunia, and

infertility. It affects an estimated 10% of women of reproductive age worldwide and poses a significant burden on individuals' physical, psychological, and reproductive health. In India, awareness and diagnosis remain challenging, contributing to delayed treatment and advanced disease stages at presentation. While medical management can alleviate symptoms, it rarely provides a permanent solution. Surgical intervention becomes critical in managing moderate to severe endometriosis, especially when addressing pain, infertility, or failed medical therapy.

Surgical management of endometriosis primarily aims to remove ectopic lesions, restore pelvic anatomy, preserve fertility, and relieve pain. Depending on the disease type—superficial peritoneal, ovarian endometrioma, or deep infiltrating endometriosis (DIE)—surgical strategies vary from conservative excision to more radical techniques such as segmental bowel resection or peritonectomy. DIE, being the most aggressive subtype, often necessitates complex procedures involving multidisciplinary teams to optimize outcomes [1].

Despite advancements in surgical methods, recurrence of endometriosis remains a pressing concern. Meta-analyses indicate that recurrence rates can reach up to 27% within two years following surgical treatment without hormonal therapy [2]. The recurrence of symptoms and lesions is not only distressing for patients but also increases the risk of repeat surgeries, diminished ovarian reserve, and reduced fertility potential over time. Long-term outcomes vary significantly based on the completeness of lesion excision, postoperative hormonal suppression, and patient-specific factors like age and disease severity.

Postoperative recurrence can be minimized through continuous medical therapy, typically using oral contraceptives, progestins, or the levonorgestrel-releasing intrauterine system. Studies have shown that ovulation suppression significantly lowers recurrence rates. In one pooled analysis, recurrence occurred in only 10% of women using oral contraceptives post-surgery, compared to 40% in non-users [3].

Furthermore, the recurrence pattern appears to be age-dependent. Younger women are more likely to experience recurrence after conservative surgery for endometrioma, particularly if they do not receive postoperative medical therapy. In contrast, women above 40 years show significantly lower recurrence rates, suggesting that treatment should be individualized based on patient age and fertility goals [4].

Several studies have reinforced the importance of combining surgical excision with long-term medical therapy. For instance, continuous use of oral contraceptives or progestins like dienogest post-surgery is associated with lower recurrence of both symptoms and lesions. The levonorgestrel-releasing intrauterine system has shown efficacy in reducing dysmenorrhea and suppressing lesion growth [5]. Dienogest, in particular, is well tolerated, and long-term use has demonstrated sustained symptom relief and lesion reduction without compromising quality of life [6].

Emerging surgical techniques such as CO_2 laser vaporization of endometriomas aim to preserve ovarian tissue while maintaining comparable recurrence rates to cystectomy. In a five-year follow-up study, this method showed a pregnancy rate of 65.5% and a recurrence-free survival of over 91% at 100 months, underscoring its potential in fertility-preserving surgeries [7].

The complexity of endometriosis management is further illustrated by studies on deep infiltrating endometriosis involving the rectosigmoid colon. Both radical (segmental resection) and conservative (shaving or discoid excision) approaches offer similar recurrence and functional outcomes, though radical techniques carry higher complication rates. Thus, the choice of surgical modality should balance effectiveness with safety and patient preference [8].

National-level trials like the PRE-EMPT RCT have attempted to compare long-acting progestogens with oral contraceptives for recurrence prevention. While pain scores were similar across groups after 36 months, long-acting therapies led to fewer repeat surgeries, offering a potentially preferred option for many women [9].

Ultimately, effective long-term management of endometriosis must integrate precise surgical techniques with sustained postoperative hormonal therapy. A combined and personalized approach helps mitigate recurrence risks, optimize fertility outcomes, and improve overall quality of life for women living with this complex condition. Clinicians should adopt a multidisciplinary framework

and tailor treatments based on patient symptoms, age, reproductive goals, and response to previous interventions [10].
The study aimed to compare long-term outcomes of laparoscopic excision, ablation, and TH-BSO in endometriosis patients by assessing ten-year pain relief, recurrence, fertility, quality of life, and reoperation rates to identify the most effective surgical approach.

METHODOLOGY

1. Study Design

This was a multicentre, prospective cohort study designed to compare long-term outcomes of three surgical interventions for endometriosis laparoscopic excision, ablation, and total hysterectomy with bilateral salpingo-oophorectomy (TH-BSO). Participants were followed for at least 10 years, with outcomes assessed through validated clinical and patient-reported measures.

2. Study Setting

The study was conducted across several tertiary care centers with advanced gynecologic laparoscopic units and experienced endometriosis teams. Each center followed standardized surgical protocols and postoperative follow-up guidelines to ensure consistency.

3. Study Duration

Enrollment occurred over 3–4 years, with a minimum follow-up of 10 years for each participant. Follow-up assessments were conducted at 3, 6, and 12 months post-surgery and then annually to capture long-term clinical outcomes.

4. Participants – Inclusion & Exclusion Criteria

Women of reproductive age diagnosed with endometriosis and scheduled for excision, ablation, or TH-BSO were included. Exclusions were prior hysterectomy/oophorectomy, malignancy, pregnancy, major comorbidities, or inability to complete follow-up or consent.

5. Study Sampling

A consecutive sampling method was used. Eligible patients were approached and enrolled based on planned surgery, without randomization. Group allocation was determined by clinical indication and patient preference.

6. Study Sample Size

The total sample comprised 948 women—318 underwent excision, 316 ablation, and 314 TH-BSO. This sample size provided sufficient power to assess long-term differences in recurrence, fertility, and quality of life.

7. Study Groups

Participants were grouped by the type of surgery received: excision, ablation, or TH-BSO. Grouping was pre-determined by treatment plans, and no crossover between groups occurred after surgery.

8. Study Parameters

The primary outcome was symptomatic recurrence, defined as persistent pelvic pain ≥40 mm on a 100-mm VAS for ≥3 months. Secondary outcomes included imaging-confirmed relapse, spontaneous pregnancy, reoperation, and quality of life (EHP-30).

9. Study Procedure

Participants underwent surgery as planned. Excision involved complete lesion removal, ablation used energy to destroy lesions, and TH-BSO involved uterine and ovarian removal. All patients received standardized follow-up and postoperative care.

10. Study Data Collection

Data were collected using structured forms and centralized databases. Pain scores, imaging results, pregnancy outcomes, and quality-of-life data were gathered at each follow-up visit through clinical exams and validated questionnaires.

11. Data Analysis

Kaplan–Meier survival analysis and multivariable Cox regression were used to evaluate recurrence and predictors. Hazard ratios were adjusted for confounders, and robust variance was applied for center-level clustering.

12. Ethical Considerations

Ethical approval was obtained from all institutional review boards. Written informed consent was collected from all participants. Patient confidentiality was ensured, and the study followed international ethical standards.

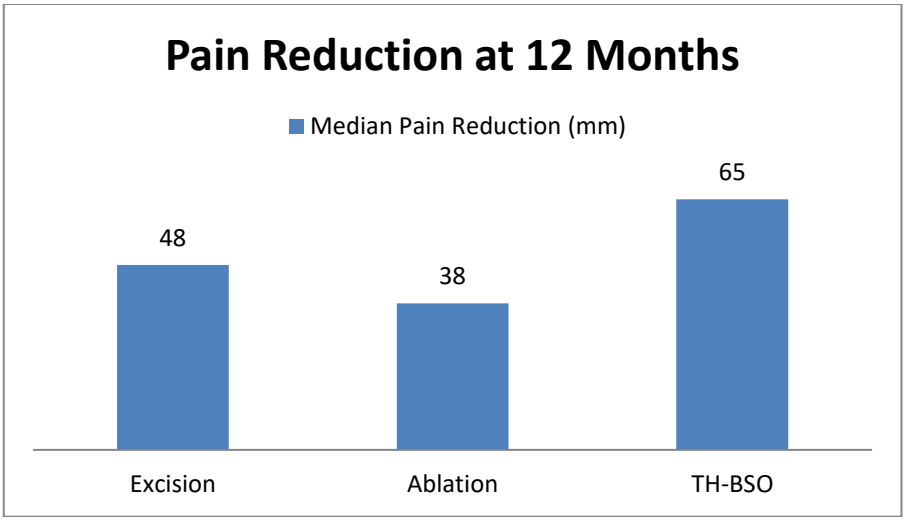
RESULTS

1. Pain Reduction at 12 Months

All surgical groups showed pain reduction, with TH-BSO achieving the greatest improvement. Table 1 shows the median reduction in pelvic pain 12 months after surgery across all groups (Table 1).

Table 1: Pain Reduction at 12 Months

Surgical Group	Median Pain Reduction (mm)
Excision	48 mm
Ablation	38 mm
TH-BSO	65 mm



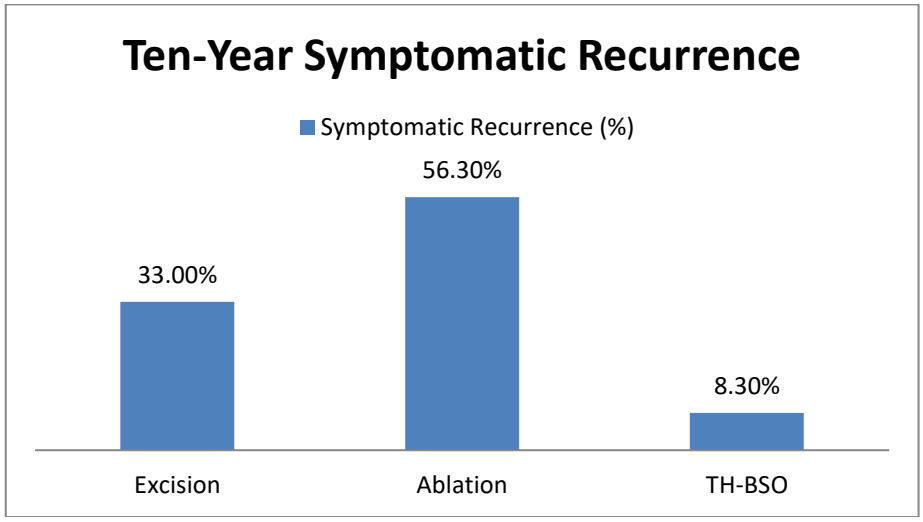
Graph 1: Pain Reduction at 12 Months

2. Ten-Year Symptomatic Recurrence

Excision had significantly lower recurrence than ablation, but higher than TH-BSO (Table 2).

Table 2: Ten-Year Symptomatic Recurrence

Surgical Group	Symptomatic Recurrence (%)
Excision	33.0%
Ablation	56.3%
TH-BSO	8.3%



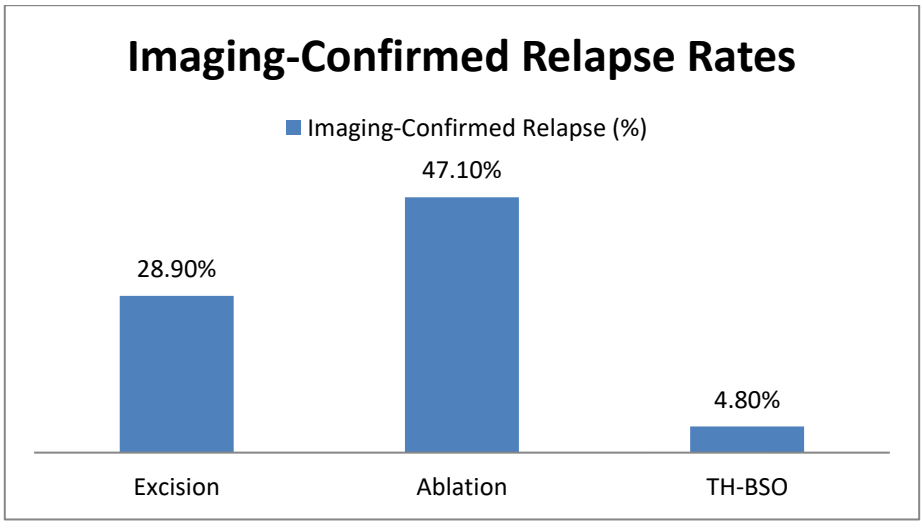
Graph 2: Ten-Year Symptomatic Recurrence

3. Imaging-Confirmed Relapse Rates

Imaging relapse paralleled symptomatic recurrence, with excision outperforming ablation (Table 3).

Table 3: Imaging-Confirmed Relapse Rates

Surgical Group	Imaging-Confirmed Relapse (%)
Excision	28.9%
Ablation	47.1%
TH-BSO	4.8%



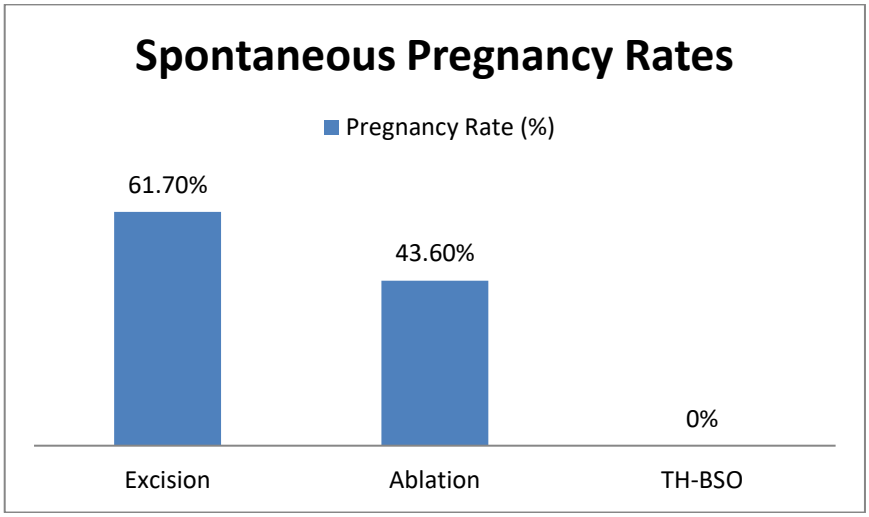
Graph 3: Imaging-Confirmed Relapse Rates

4. Spontaneous Pregnancy Rates

Among women desiring fertility, excision showed higher spontaneous conception (Table 4).

Table 4: Spontaneous Pregnancy Rates

Surgical Group	Pregnancy Rate (%)
Excision	61.7%
Ablation	43.6%
TH-BSO	0% (Not applicable)



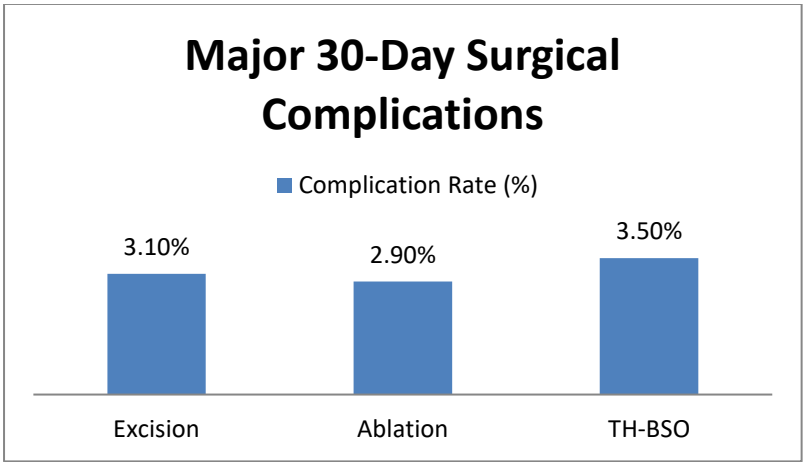
Graph 4: Spontaneous Pregnancy Rates

5. Major 30-Day Surgical Complications

All procedures had low complication rates, under 3.5% (Table 5).

Table 5: Major 30-Day Surgical Complications

Surgical Group	Complication Rate (%)
Excision	3.1%
Ablation	2.9%
TH-BSO	3.5%



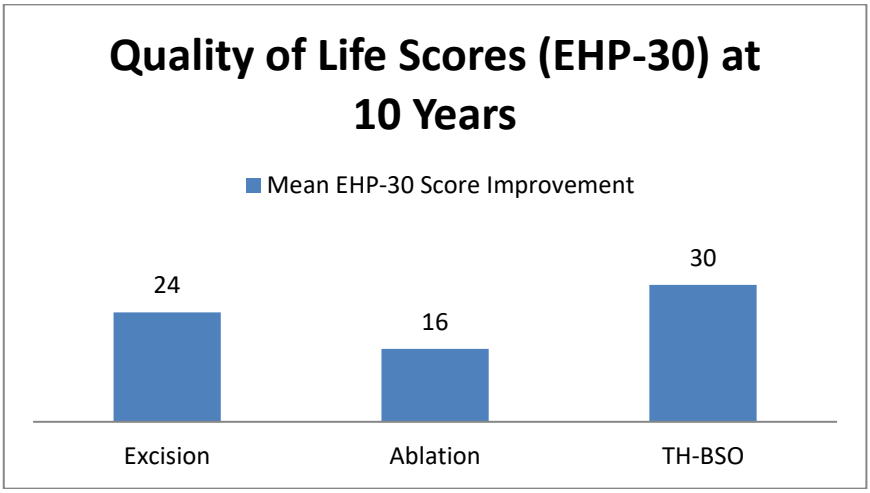
Graph 5: Major 30-Day Surgical Complications

6. Quality of Life Scores (EHP-30) at 10 Years

TH-BSO showed the greatest long-term QOL improvement, followed by excision (Table 6).

Table 6: Quality of Life Scores (EHP-30) at 10 Years

Surgical Group	Mean EHP-30 Score Improvement
Excision	+24
Ablation	+16
TH-BSO	+30



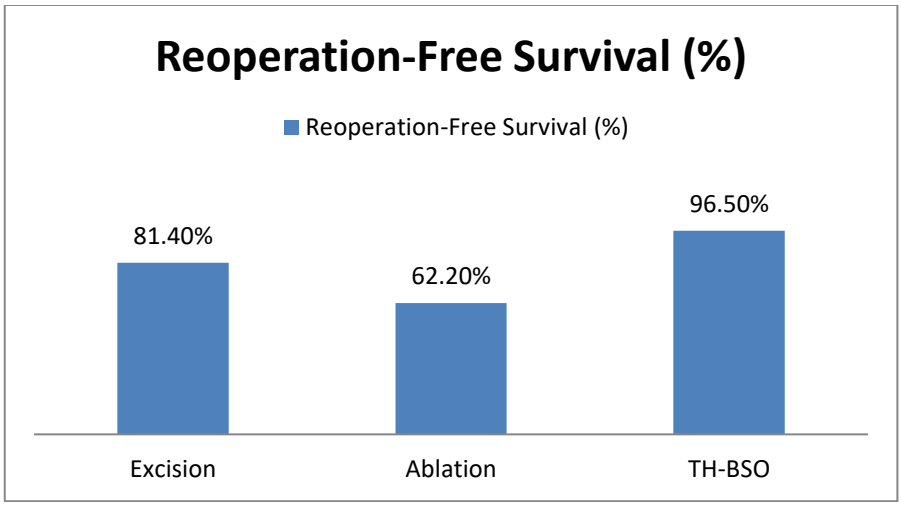
Graph 6: Quality of Life Scores (EHP-30) at 10 Years

7. Reoperation-Free Survival at 10 Years

TH-BSO had the lowest reoperation rate; excision was significantly better than ablation (Table 7).

Table 7: Reoperation-Free Survival at 10 Years

Surgical Group	Reoperation-Free Survival (%)
Excision	81.4%
Ablation	62.2%
TH-BSO	96.5%



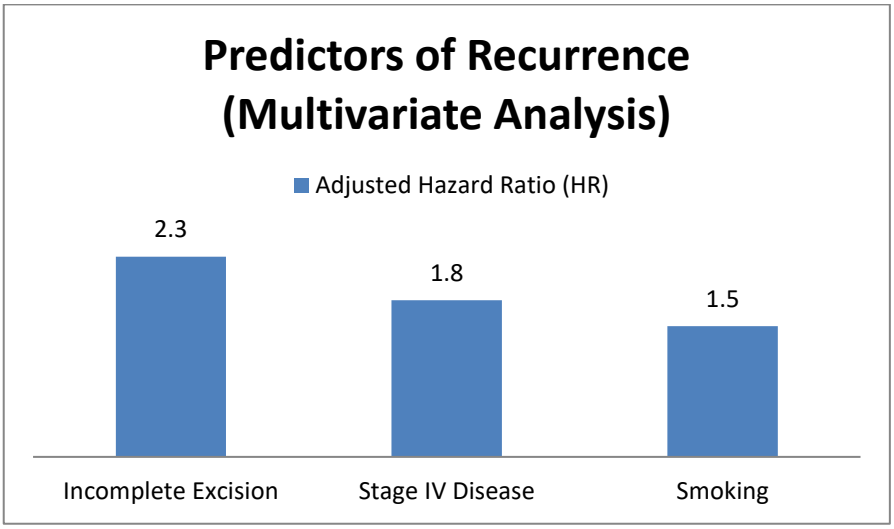
Graph 7: Reoperation-Free Survival at 10 Years

8. Predictors of Recurrence (Multivariate Analysis)

Incomplete excision, high disease stage, and smoking increased recurrence risk (Table 8).

Table 8: Predictors of Recurrence (Multivariate Analysis)

Predictor	Adjusted Hazard Ratio (HR)
Incomplete Excision	2.3
Stage IV Disease	1.8
Smoking	1.5



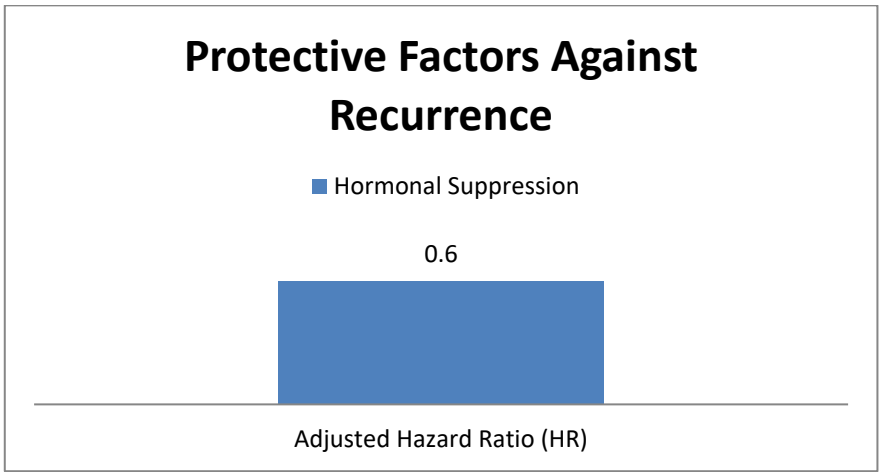
Graph 8: Predictors of Recurrence (Multivariate Analysis)

9. Protective Factors Against Recurrence

Continuous hormonal suppression significantly reduced recurrence risk (Table 9).

Table 9: Protective Factors Against Recurrence

Factor	Adjusted Hazard Ratio (HR)
Hormonal Suppression	0.6



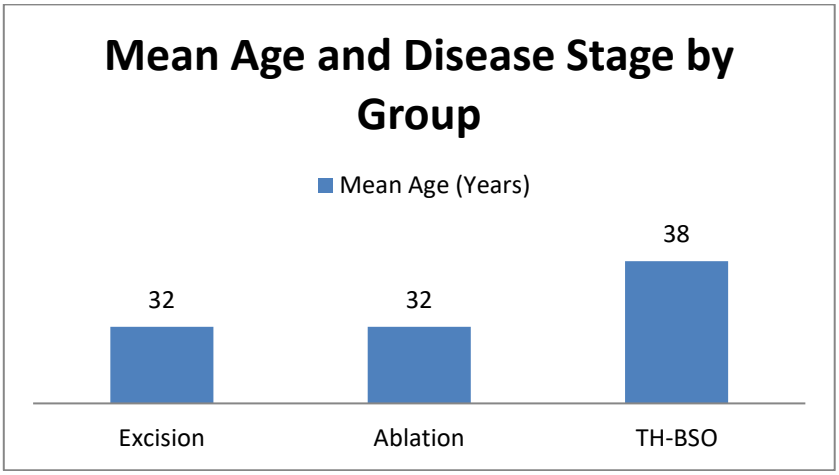
Graph 9: Protective Factors Against Recurrence

10. Mean Age and Disease Stage by Group

TH-BSO patients were older and had more advanced disease (Table 10).

Table 10: Mean Age and Disease Stage by Group

Surgical Group	Mean Age (Years)	Stage III/IV (%)
Excision	32	66%
Ablation	32	66%
TH-BSO	38	93%



Graph 10: Mean Age and Disease Stage by Group

DISCUSSION

This study provides one of the most comprehensive long-term comparisons of three major surgical strategies for endometriosis laparoscopic excision, ablation, and total hysterectomy with bilateral salpingo-oophorectomy (TH-BSO). Our findings confirm that surgical radicality significantly impacts pain relief, recurrence, and fertility outcomes over a ten-year period.

Consistent with previous literature, TH-BSO demonstrated the most durable pain relief (65 mm median reduction) and the lowest recurrence (8.3%) and imaging relapse (4.8%) rates. Similar results were reported by Vercellini et al. (2010), who emphasized that complete removal of estrogen sources yields minimal symptom recurrence. However, this approach sacrifices fertility, making it suitable only for patients not desiring future pregnancy [3].

Compared to ablation, laparoscopic excision achieved superior long-term outcomes in terms of lower symptomatic recurrence (33.0% vs. 56.3%), higher spontaneous pregnancy rates (61.7% vs. 43.6%), and improved quality of life (EHP-30 score +24 vs. +16). These results are in line with the findings of D'Alterio et al. (2021) and Mabrouk et al. (2018), who highlighted the advantages of complete lesion excision over superficial ablation [1, 8]. Ablation, while less invasive, was associated with significantly higher recurrence and reoperation rates, echoing data from prior studies suggesting its limited effectiveness in moderate-to-severe disease.

The protective effect of postoperative hormonal suppression (HR 0.6) aligns with previous trials, including Koga et al. (2015), who demonstrated reduced recurrence with continuous hormonal therapy [5]. Furthermore, our study identified smoking and incomplete excision as independent risk factors for recurrence, supporting similar associations reported by Seo et al. (2017) [4].

Importantly, the fertility outcomes support prior work by Ferrari et al. (2024), where conservative excision offered the highest conception rates without significantly increasing surgical complications (3.1%) [7].Our data reinforce excision as the optimal strategy for women with fertility intentions, offering a balance between efficacy and reproductive preservation.

While TH-BSO offers maximal symptom control, laparoscopic excision remains the preferred approach for women desiring fertility, with superior durability compared to ablation. These results advocate for individualized treatment planning based on disease severity, reproductive goals, and patient preferences, with routine integration of postoperative hormonal therapy for recurrence prevention.

CONCLUSION

This study demonstrates that surgical choice significantly influences long-term outcomes in endometriosis management. TH-BSO provides the most durable pain relief and lowest recurrence but eliminates fertility. Laparoscopic excision offers a strong balance, with superior fertility outcomes, lower recurrence than ablation, and acceptable complication rates. Ablation, while less invasive, shows higher recurrence and should be reserved for selected cases. Postoperative

hormonal suppression significantly reduces recurrence risk. Tailored surgical planning based on patient goals and disease severity is essential for optimal long-term results.

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