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ORIGINAL RESEARCH

Hyaluronic Acid Barrier Gel for Preventing Adhesions After Hysteroscopic Myomectomy of Large Submucosal Myomas

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Purpose: To evaluate the effectiveness of an intrauterine hyaluronic acid–based barrier gel in reducing postoperative intrauterine adhesions (IUAs) following hysteroscopic myomectomy for large submucosal myomas.

Patients and Methods: This retrospective study reviewed the medical records of 62 women who underwent hysteroscopic myomectomy for submucosal myomas ≥3 cm between January 2022 and June 2025. Thirty-three patients received intrauterine application of a hyaluronic acid–based barrier gel at the end of surgery, while 29 patients received no anti-adhesion barrier. The **primary outcome** was the incidence and severity of postoperative IUAs, assessed by second-look hysteroscopy at 12 weeks using the American Fertility Society scoring system. Secondary outcomes included postoperative menstrual characteristics (PBAC scores), cyclic pelvic pain, and endometrial thickness.

Results: Baseline demographic and clinical characteristics were comparable between groups. The incidence of IUAs was significantly lower in the hyaluronic acid gel group compared with controls (6.1% vs 31.0%; p=0.01). The mean total adhesion score was also significantly reduced (0.27 ± 0.89 vs 1.52 ± 2.13; p=0.031). Moderate or severe adhesions occurred only in the control group, although this difference did not reach statistical significance. Postoperative menstrual outcomes and cyclic pelvic pain rates were similar between groups. Endometrial thickness at follow-up tended to be higher in the gel group (7.2 ± 0.9 vs 6.8 ± 0.8 mm; p=0.07).

Conclusion: Intrauterine administration of a hyaluronic acid–based barrier gel following hysteroscopic myomectomy for large submucosal myomas significantly reduces the incidence and severity of postoperative intrauterine adhesions, supporting its use as an effective strategy to optimize postoperative uterine cavity outcomes.

Keywords: hyaluronic acid barrier gel, intrauterine adhesions, hysteroscopic myomectomy, submucosal fibroids, adhesion prevention, second-look hysteroscopy

Introduction

IUAs are pathological fibrotic bands that form within the uterine cavity as a result of damage to the basal layer of the endometrium. Clinically, IUAs may present with hypomenorrhea, amenorrhea, recurrent pregnancy loss, and infertility, potentially leading to long-term adverse effects on women's reproductive health.[1,2]

Uterine fibroids are commonly classified according to the International Federation of Gynecology and Obstetrics (FIGO) system, which categorizes fibroids from type 0 to type 8 based on their relationship to the endometrial cavity and myometrium. Submucosal fibroids (FIGO types 0, 1, and 2) are particularly relevant in this context, as they distort the uterine cavity and are most strongly associated with abnormal uterine bleeding and reproductive dysfunction. Among these, FIGO type 0 and type 1 fibroids are most frequently managed hysteroscopically, whereas larger type 2 lesions often require more extensive resection and carry a higher risk of endometrial injury.

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Although hysteroscopic myomectomy is a minimally invasive and effective technique for the treatment of submucosal fibroids, the procedure itself involves endometrial trauma and poses a significant risk for the development of IUAs.[2]

Hysteroscopy represents the gold standard for both the diagnosis and treatment of submucosal fibroids, allowing direct visualization of the uterine cavity and targeted resection while preserving surrounding myometrial tissue. However, the extent of endometrial damage during hysteroscopic myomectomy largely depends on fibroid size, depth of myometrial penetration, and the surface area of denuded endometrium.

The incidence of IUAs varies considerably depending on the number, size, and location of the resected fibroids. In particular, the removal of large (≥3 cm) and apposing submucosal fibroids substantially increases the risk of adhesion formation due to extensive surface trauma and the apposition of raw endometrial areas. Some studies have reported adhesion rates as high as 78% in such cases.[3,4] Therefore, this patient subgroup is considered to be at high risk for postoperative adhesion development.

Hysteroscopic myomectomy of large submucosal fibroids is technically more challenging than the resection of smaller lesions, often requiring prolonged operative time, deeper myometrial resection, and wider endometrial denudation. These factors may compromise endometrial regeneration and further predispose patients to adhesion formation, particularly when opposing uterine walls are involved. Consequently, strategies for adhesion prevention may be of greater clinical importance in this high-risk subgroup.

To mitigate this risk, a variety of preventive strategies have been proposed, including hormonal therapies, intrauterine mechanical barriers, and biological barrier agents.[5,6] Among these, hyaluronic acid-based barrier gels have garnered increasing attention in recent years. These agents form a temporary physical barrier between the injured endometrial surfaces, thereby promoting epithelial regeneration and reducing the likelihood of adhesion formation.[7]

Although hyaluronic acid–based barriers have demonstrated efficacy in reducing IUAs after hysteroscopic procedures, the majority of available studies have included heterogeneous patient populations or focused on smaller submucosal fibroids. Evidence specifically addressing their effectiveness in women undergoing hysteroscopic myomectomy for large submucosal fibroids remains limited.

However, comparative data regarding their efficacy in high-risk patients—particularly those undergoing resection of large submucosal fibroids—remain limited. While several studies have evaluated these gels in comparison to other barrier methods, direct comparisons between hyaluronic acid-based barriers and no-barrier management in the context of large fibroid resections are still insufficient. Notably, patients in this subgroup are among those who may benefit the most from strategies aimed at preserving endometrial integrity following surgery.[8,9]

We hypothesized that intrauterine application of a hyaluronic acid–based barrier gel would significantly reduce the incidence and severity of postoperative intrauterine adhesions in women undergoing hysteroscopic myomectomy for large submucosal fibroids.

In this context, the present retrospective comparative study aims to evaluate the effectiveness of intrauterine application of a hyaluronic acid-based barrier gel in preventing postoperative IUAs in women undergoing hysteroscopic resection of large submucosal fibroids, compared to those who received no barrier intervention.

Materials and Methods

Study Design and Setting

This was a retrospective comparative cohort study conducted at the Department of Obstetrics and Gynecology of a tertiary care referral center between January 2022 and June 2025. All procedures were performed at the same institution following a standardized institutional protocol for hysteroscopic myomectomy.

Patient Selection

This retrospective comparative study included women aged between 18 and 45 years who underwent single-session hysteroscopic resection of submucosal myomas measuring ≥3 cm in diameter using bipolar energy. Eligible patients were required to have adequate postoperative follow-up, to have undergone second-look hysteroscopy within 12 weeks after surgery, and to have not received any mechanical barrier (intrauterine device or Foley catheter) other than the

hyaluronic acid-based barrier gel. Patients were excluded if they had a diagnosis or clinical suspicion of endometrial malignancy, a history of Asherman's syndrome, congenital uterine anomalies, or incomplete surgical or follow-up data. A total of 62 patients meeting these criteria were included in the study. Among them, 33 patients received intrauterine hyaluronic acid-based barrier gel at the end of the procedure, while 29 patients did not receive any barrier intervention. Patients were allocated to the hyaluronic acid–based barrier gel group or the control group retrospectively based on intraoperative use of the barrier gel as part of routine surgical practice. Demographic characteristics, gynecological history, surgical details, and postoperative follow-up findings of all patients were retrospectively reviewed and analyzed comparatively between the two groups. Potential confounding variables, including myoma size, number, and FIGO classification (type 0–2), were recorded for all patients and were comparable between the two groups at baseline.

Data Collection

Data were collected retrospectively from electronic medical records and institutional hospital archives using a standardized data extraction form. Variables collected included patient demographics, reproductive history, fibroid characteristics, surgical parameters, postoperative outcomes, and second-look hysteroscopy findings. Data extraction was performed by manual chart review by two independent investigators to ensure data accuracy and completeness.

Surgical Procedure

All procedures were conducted under regional anesthesia in the lithotomy position. After appropriate antiseptic preparation and bladder catheterization, a 9-mm bipolar resectoscope was introduced into the uterine cavity using normal saline solution as the distension medium, maintained under constant low-pressure infusion (80–100 mmHg) to optimize visualization and minimize fluid overload risk. The procedure was performed under continuous hysteroscopic guidance, with real-time ultrasound monitoring in selected cases to enhance intraoperative safety. All surgeries were performed or directly supervised by senior gynecologic surgeons experienced in hysteroscopic procedures, and a uniform surgical technique was applied across cases to ensure procedural standardization.

Submucosal fibroids were classified preoperatively and intraoperatively using the FIGO system, and only type 0 (entirely intracavitary), type 1 (<50% intramural), and type 2 (≥50% intramural) fibroids were eligible for inclusion. Myomas ≥3 cm in diameter were targeted. The fibroid tissue was progressively resected using the bipolar loop electrode, employing a slicing technique from the apex toward the base, minimizing injury to the surrounding endometrium and myometrium. Hemostasis was achieved using coagulation settings as needed.

Complete excision of the fibroid was confirmed hysteroscopically in all cases. Following removal of all resected fragments and careful inspection of the uterine cavity for residual myoma tissue or bleeding points, the resectoscope was withdrawn. Subsequently, in patients assigned to the intervention group, 7,5 mL of hyaluronic acid-based barrier gel (Betamix®) was introduced into the uterine cavity using the prefilled sterile applicator provided by the manufacturer. Care was taken to ensure homogeneous distribution of the gel along the cavity walls.

No mechanical barriers (eg., IUDs or balloon catheters) were employed in any of the patients. Postoperatively, patients received standard analgesia and prophylactic antibiotics. All participants were discharged within 24 hours and followed up as per study protocol. No major intraoperative complications such as uterine perforation, excessive bleeding requiring transfusion, or fluid overload syndrome were observed during the procedures.

Follow-Up and Outcome Evaluation

At 12 weeks postoperatively, all patients underwent a standardized second-look diagnostic hysteroscopy. During this procedure, the presence, extent, and location of IUAs were evaluated and scored using the AFS classification system. The primary outcome was the incidence and severity of postoperative intrauterine adhesion (IUA) formation. Secondary outcome measures were predefined and included:Total AFS score, changes in menstrual volume assessed by the Pictorial Blood Loss Assessment Chart (PBAC), presence and severity of pelvic pain assessed using a 10-point visual analog scale (VAS), endometrial thickness and uterine cavity morphology assessed by transvaginal ultrasonography.

To assess morphological improvement of the uterine cavity, endometrial thickness was measured by transvaginal ultrasonography during the late proliferative phase (day 10–14 of the menstrual cycle). A normal endometrial appearance was defined as:

- Thickness between 3–8 mm in the proliferative phase,
- Smooth and regular endometrial contours,
- Absence of intrauterine structural abnormalities such as scarring or deformation.

These ultrasonographic criteria were applied consistently using the same imaging system across all evaluations. All follow-up assessments were performed using standardized protocols to minimize interobserver variability.

Pictorial Blood Loss Assessment Chart

Menstrual blood loss was evaluated using the PBAC, a semi-quantitative method based on patient-reported pad/tampon usage and saturation level. Light, moderate, full, and leaking items were scored as 1, 5, 10, and 20 points, respectively, with an additional 5 points for each blood clot >1 cm. The total PBAC score per cycle was calculated accordingly, with scores ≥100 considered indicative of heavy menstrual bleeding.[10] Menstrual blood loss was assessed using the PBAC preoperatively and at the 12 weeks postoperative follow-up.

Classification of Intrauterine Adhesions

The severity of intrauterine adhesions was evaluated using the AFS classification system. This system is based on three parameters: the extent of uterine cavity involvement, the density of adhesions, and the menstrual pattern. Each parameter is scored, and the total score determines the overall severity. A total AFS score of 1–4 indicates mild, 5–8 moderate, and 9–12 severe adhesions. This scoring system enables standardized and comparable assessment of intrauterine adhesions.[11]

Statistical Analysis

Prior to data analysis, a power calculation was performed to determine the minimum sample size required to detect a clinically meaningful difference in the incidence of postoperative IUAs between patients who received a hyaluronic acid-based barrier gel and those who received no barrier intervention following hysteroscopic resection of large submucosal myomas. Based on previous studies, the expected adhesion rate in high-risk patients without any adhesion-preventive strategy was estimated at approximately 45%, while the use of barrier gel was hypothesized to reduce this rate to 15–20%. Using a two-sided alpha level of 0.05 and aiming for 80% power, a minimum of 30 patients per group was calculated to be sufficient to detect this difference. Therefore, the total sample size of 62 patients (33 in the barrier group and 29 in the control group) was deemed adequate for the purpose of the study. Data were analyzed using SPSS version 26.0. Categorical variables were expressed as frequencies and percentages, and compared using the chi-square or Fisher's exact test as appropriate. Continuous variables were expressed as mean ± standard deviation or median (interquartile range), and compared using Student's *t*-test or Mann–Whitney *U*-test depending on distribution. A p-value of <0.05 was considered statistically significant.

Results

A total of 62 patients were included in the final analysis, with 33 in the hyaluronic acid-based barrier gel group and 29 in the control group. Baseline demographic and clinical characteristics were comparable between the two groups (Table 1). There were no statistically significant differences in mean age (37.8 ± 6.1 vs. 38.1 ± 5.9 years, $p = 0.84$) or BMI (25.4 ± 5.3 vs. 26.1 ± 7.1 kg/m^2, $p = 0.83$). Smoking prevalence, parity distribution, history of previous uterine surgery, and preoperative myoma size and type were also similar (all $p > 0.05$). Menstrual pattern before treatment, presence of cyclic pelvic pain, infertility type, prior IUAs, perioperative hemoglobin change, and operative time did not differ significantly between groups.

Postoperative hysteroscopic findings demonstrated a markedly lower incidence of IUA in the hyaluronic acid-based barrier gel group compared with controls (6.1% vs. 31.0%, $p = 0.01$). The mean total AFS adhesion score was also significantly lower in the intervention group (0.27 ± 0.89) than in the control group (1.52 ± 2.13, $p = 0.031$) (Table 2 and

Table 1 Baseline Demographic, Clinical, and Surgical Characteristics of Women Undergoing Hysteroscopic Resection of Large (≥3 Cm) Submucosal Fibroids at a Tertiary Referral Center Between January 2022 and June 2025, According to Hyaluronic Acid–Based Barrier Gel Use

Characteristics	HA-Based Barrier Group (n=33)	Control Group (n=29)	P value
Age (years)	37.8 ± 6.1	38.1 ± 5.9	0.84
BMI (kg/m^2)	25.4 ± 5.3	26.1 ± 7.1	0.83
Smoking status, n (%) Yes No	 10 (30) 23 (70)	 11 (38) 18 (62)	0,59
Parity, n (%) 0 1-2 3-4 ≥5	 7(21) 19 (57) 4(12) 3(10)	 5(17) 15 (52) 5(17) 4(14)	0.84
Previous uterine surgery, n (%)	8 (24.2)	8 (27.5)	0.78
Size of uterine myoma(cm)	3,51± 0.41	3.45 ± 0.33	0,62
Types of uterine myoma, n (%) 0 1 2	 11 (33) 15 (45) 7(22)	 10 (34) 13 (46) 6(20)	0.91
Menstrual Pattern Before Treatment, n (%) Eumenorrhea Hypomenorrhea Hypermenorrhea	 10 (30) 2(6) 21 (64)	 7 (24) 3 (10) 19 (66)	0.75
Cyclic pelvic pain, n (%)	7 (22)	8 (27.5)	0.76
Severity Of Pelvic Pain (VAS Score)	5 (15)	6 (20)	0.25
Infertility, n (%) Primary Secondary	14 (42) 6 (18) 8 (24)	15 (51) 8 (27) 7 (24)	0.85
Previous IUA, n (%)	1 (3)	1 (3)	1
ΔHemoglobine (g/dl)*	0.6 ± 0.5	0.7 ± 0.4	0.27
Surgery time (min)	37± 15	35 ± 14	0.61

Notes:*ΔHemoglobin: The difference between preoperative and postoperative day 1 hemoglobin levels (g/dL).
Abbreviations: VAS, visual analog scale; BMI, body mass index.

Figure 1). When adhesion severity was stratified, mild adhesions (AFS score 1–4) were observed in 6.1% of patients in the HA group and 17.2% in the control group ($p = 0.237$), whereas moderate (AFS score 5–8) and severe adhesions (AFS score 9–12) occurred only in the control group, without reaching statistical significance.

In multivariable logistic regression analysis, the use of a hyaluronic acid–based barrier gel was independently associated with a reduced risk of postoperative intrauterine adhesion formation (adjusted OR 0.18, 95% CI 0.03–0.95; p = 0.044). Myoma size was not significantly associated with adhesion formation after adjustment (adjusted OR 1.42, 95% CI 0.72–2.81; p = 0.31). Similarly, FIGO type 2 fibroids were not independently associated with an increased risk of postoperative adhesions compared with FIGO types 0–1 (adjusted OR 1.67, 95% CI 0.39–7.14; p = 0.49) (Table 3).

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Table 2 Postoperative Outcomes of Women Undergoing Hysteroscopic Resection of Large (≥3 Cm) Submucosal Fibroids at a Tertiary Referral Center Between 2022 and 2025

Characteristics	HA-Based Barrier Group (n = 33)	Control Group (n = 29)	P value
Intrauterine adhesion (IUA)	2 (6)	9 (31)	0.01
Total AFS score	0.27 ± 0.89	1.52 ± 2.13	0.031
Type of adhesions (score) Mild (1–4), n (%) Moderate (5–8), n (%) Severe (9–12), n (%)	 2 (6.1) 0 (0) 0 (0)	 5 (17.2) 3 (10.3) 1 (3.4)	 0.237 NA NA
Preoperative PBAC score	118.2 ± 26.7	115.4 ± 28.1	0.68
Postoperative PBAC score	94.5 ± 22.3	92.8 ± 23.7	0.74
Menstrual volume change Less than before Same as before More than before	 21 (64) 10 (30) 2 (6)	 18 (63) 8 (27) 3(10)	 0.89 0.81 0.65
Amenorrhea	1 (3)	1 (3)	1.000
Endometrial thickness(mm)	7.2 ± 0.9	6.8 ± 0.8	0.07
Cyclic pelvic pain, n (%)	2 (6)	3 (10)	0.65

Abbreviations: AFS, American Fertility Society adhesion score; PBAC, Pictorial Blood Loss Assessment Chart.

Menstrual outcomes did not differ significantly between the groups. Preoperative and postoperative PBAC scores showed comparable reductions, with mean postoperative values of 94.5 ± 22.3 in the hyaluronic acid-based barrier gel group and 92.8 ± 23.7 in controls ($p = 0.74$). Changes in menstrual volume were similar, with most patients reporting no

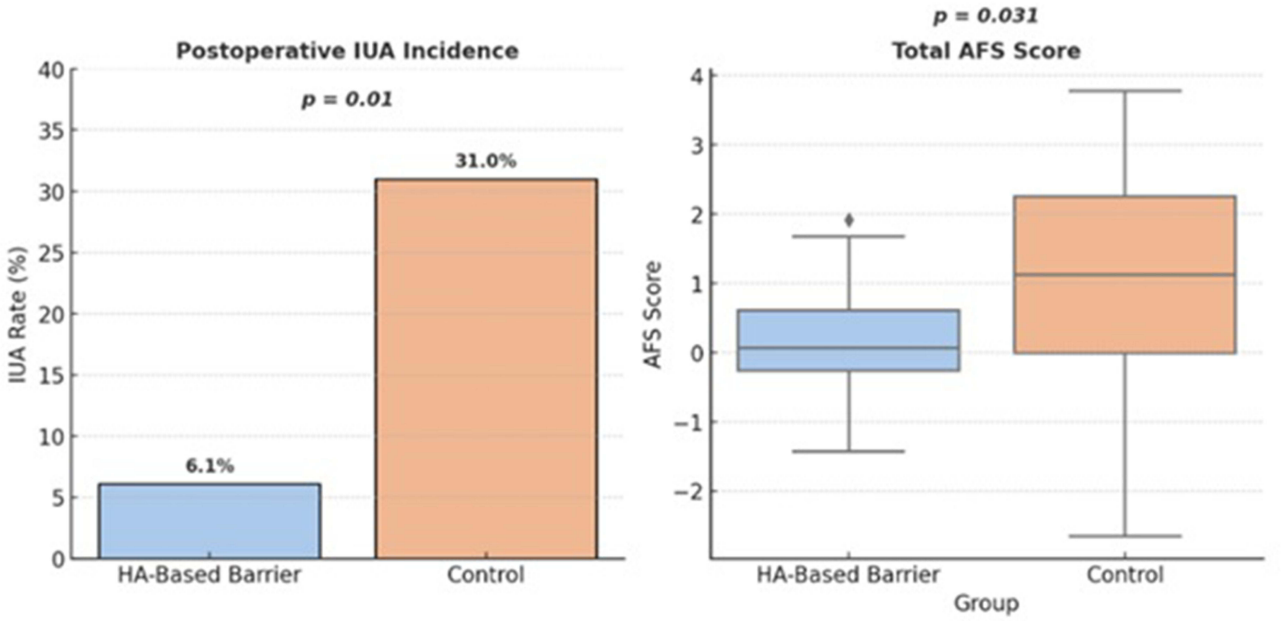

Figure 1 Postoperative intrauterine adhesion rates and total AFS scores in women undergoing hysteroscopic resection of large (≥3 cm) submucosal fibroids at a tertiary referral center between January 2022 and June 2025.

Table 3 Multivariable Logistic Regression Analysis of Factors Associated with Postoperative Intrauterine Adhesion Formation in Women Undergoing Hysteroscopic Resection of Large (≥3 Cm) Submucosal Fibroids at a Tertiary Referral Center Between January 2022 and June 2025

Variable	Adjusted OR	95% CI	p value
HA-based barrier gel use	0.18	0.03–0.95	0.044
Myoma size (per cm increase)	1.42	0.72–2.81	0.31
FIGO type 2 vs 0–1	1.67	0.39–7.14	0.49

Abbreviations: HA, Hyaluronic Acid; FIGO, International Federation of Gynecology and Obstetrics.

change or a decrease. Amenorrhea was rare and occurred in one patient in each group. Postoperative endometrial thickness tended to be higher in the hyaluronic acid-based barrier gel group compared with controls (7.2 ± 0.9 mm vs. 6.80 ± 0.8 mm), but the difference did not reach statistical significance ($p = 0.07$). Cyclic pelvic pain rates were also comparable between groups.

Overall, the hyaluronic acid-based barrier gel was associated with a significant reduction in postoperative adhesion formation and total AFS scores, particularly in a high-risk population undergoing hysteroscopic resection of large submucosal myomas.

Although some secondary outcomes did not reach statistical significance, clinically relevant trends were observed. Moderate and severe intrauterine adhesions occurred exclusively in the control group, suggesting a potential protective effect of the hyaluronic acid–based barrier gel against more severe adhesion formation. Similarly, postoperative endometrial thickness tended to be higher in the intervention group. These findings may reflect a limited sample size rather than a true absence of effect. (Table 2)

Discussion

The development of intrauterine adhesions (IUAs) following hysteroscopic myomectomy remains a significant clinical concern, particularly in resections involving large (≥3 cm) and mutually apposing submucosal fibroids. In this high-risk subgroup, the extent of endometrial trauma and the presence of opposing raw surfaces substantially increase the likelihood of adhesion formation. Previous studies have demonstrated that IUA risk rises with fibroid number, FIGO subtype, and the surface area of resection.[12–14] Notably, Yang et al reported a very high incidence of IUAs (78%) in cases involving apposed submucosal fibroids at early follow-up hysteroscopy.[12] Although more recent series describe lower overall adhesion rates after hysteroscopic myomectomy, these findings highlight the persistent need for effective adhesion-prevention strategies in complex procedures.[13]

Against this background, the primary finding of the present study is that intrauterine application of a hyaluronic acid (HA)–based barrier gel following hysteroscopic resection of large submucosal fibroids significantly reduced the incidence of postoperative IUAs from 31.0% to 6.1%. This marked reduction underscores the role of HA-based products as an important prophylactic measure in modern hysteroscopic surgery, particularly after procedures associated with extensive endometrial injury. The higher baseline adhesion rate observed in our control group compared with some previous studies likely reflects the increased surgical complexity and adhesiogenic potential of large submucosal fibroids.

Our findings are highly consistent with existing randomized controlled trials and multicenter studies evaluating HA-based barrier gels in similar surgical contexts. Chen et al demonstrated that the use of auto–cross-linked hyaluronic (ACP) gel following electrosurgical resection significantly reduced IUA incidence compared with controls.[15] Similarly, Lisa et al showed that HA-based gels such as Hyalobarrier serve as effective benchmarks for newer anti-adhesion materials, consistently lowering American Fertility Society (AFS) scores by maintaining separation of endometrial surfaces during the early healing phase.[16] These data support the generalizability of our findings within the broader hysteroscopic literature.

The protective effect of HA-based gels is primarily attributed to their function as a viscoelastic physical barrier. By separating apposing endometrial surfaces during the critical first 7–14 days of tissue repair, these gels inhibit fibroblast migration and subsequent formation of permanent fibrous bands. While alternative materials, including type I collagen, have been investigated, Lee et al reported no clinically significant differences between collagen-based products and HA/carboxymethylcellulose gels, with HA-based solutions demonstrating a consistently reliable performance profile in minimizing postoperative adhesions.[17]

In line with this mechanistic rationale, multiple randomized trials and meta-analyses have confirmed the prophylactic efficacy of HA-based barrier gels following hysteroscopic myomectomy. Huang et al reported significantly lower adhesion rates and reduced adhesion severity among patients receiving HA gel compared with controls.[18] Furthermore, a meta-analysis by Cheng et al focusing specifically on hysteroscopic myomectomy, demonstrated a significant reduction in de novo IUAs with the use of HA-based barrier gels.[19] Broader systematic reviews encompassing various intrauterine procedures have similarly shown consistent reductions in IUA incidence and AFS scores associated with HA-based products.[20–22]

In the present study, the distribution of adhesion severity also favored the HA group, with moderate-to-severe IUAs observed exclusively in the control arm. This pattern parallels previous reports suggesting that HA-based barriers may not only reduce adhesion incidence but also mitigate adhesion severity. Guida et al documented lower early postoperative IUA rates in patients treated with HA-based gel compared with controls following hysteroscopic procedures.[23] More recently, Lee et al demonstrated that a thermoresponsive HA sol–gel was non-inferior to Hyalobarrier in preventing postoperative adhesions, further supporting a potential class effect of HA-based barrier agents.[7]

Regarding secondary outcomes, menstrual parameters and cyclic pelvic pain did not differ significantly between groups, while endometrial thickness showed a near-significant trend favoring the HA group. These findings are consistent with existing evidence indicating that HA-based barrier gels are safe and do not adversely affect endometrial healing.[7,15]

High-risk subgroups warrant particular consideration when implementing adhesion-prevention strategies. Patients with large FIGO type 2 submucosal fibroids, especially when resection involves extensive trauma to apposing endometrial surfaces, represent the most vulnerable population for IUA development.[12,18] In such cases, optimizing surgical technique in conjunction with effective adhesion-prevention measures is likely to yield the greatest benefit. Thermal-sparing approaches, such as the cold-loop technique, have been associated with lower adhesion rates, as reported by Mazzon et al in a large retrospective series.[24] Additionally, early second-look office hysteroscopy with lysis of newly formed adhesions has been shown to facilitate timely diagnosis and treatment.[12,25] In the present study, routine second-look hysteroscopy at 12 weeks allowed standardized assessment of both adhesion presence and severity.

Beyond surgical technique, alternative adhesion-prevention strategies have been explored, including mechanical intrauterine spacers and postoperative hormonal therapy. Although mechanical barriers may provide effective cavity separation, their use is often limited by patient discomfort, infection risk, and inconsistent evidence of superiority over biological barriers. Hormonal therapy alone appears to have limited efficacy when not combined with a physical or biological barrier. In contrast, HA-based gels offer a non-mechanical, well-tolerated option that integrates seamlessly into routine hysteroscopic practice, particularly in high-risk procedures.

Current guidelines and clinical recommendations further support this approach. The 2017 AAGL/ESGE practice report emphasizes the importance of adhesion-prevention strategies in high-risk hysteroscopic procedures and highlights the value of second-look hysteroscopy.[26] In addition, meta-analyses by Vitale et al suggest that HA-based gels may be beneficial in reducing postoperative adhesions.[6] Taken together, the available evidence supports the use of HA-based barrier gels as a rational and evidence-based strategy for adhesion prevention following hysteroscopic myomectomy in patients at increased risk.

Conclusion

The application of intrauterine hyaluronic acid-based barrier gel following resection of large submucosal myomas has been shown to reduce the incidence and severity of IUAs. When combined with optimized surgical techniques and appropriate postoperative follow-up, this approach represents a safe and feasible strategy to support endometrial healing. These findings are particularly relevant for patients undergoing high-risk hysteroscopic myomectomy and support the potential role of

hyaluronic acid–based barrier gels as part of adhesion-prevention strategies in routine clinical practice. However, further well-designed prospective randomized controlled trials, preferably with larger sample sizes and multicenter designs, including assessments of fertility outcomes, such as conception and live birth rates, are required to strengthen the quality of evidence in this field and to better define the long-term reproductive implications of adhesion prevention.

Strengths and Limitations

Strengths of this study include its focus on a single-center, homogeneous high-risk cohort undergoing resection of large (≥3 cm) submucosal fibroids, the standardized performance of second-look hysteroscopy at 12 weeks using the AFS scoring system, and the use of a protocolized surgical technique with uniform postoperative management. However, several limitations should be acknowledged. The retrospective design, relatively modest sample size, and absence of fertility-related outcomes limit causal inference and may reduce the generalizability of the findings. In addition, the retrospective nature of the study introduces the potential for selection bias, as treatment allocation may have been influenced by clinical judgment. Although baseline characteristics were comparable between groups, residual confounding due to unmeasured variables cannot be entirely excluded. Finally, the relatively small sample size restricted the feasibility of adequately powered subgroup analyses, particularly according to FIGO subtype or fertility-related endpoints.

Data Sharing Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding authors.

Ethics and Consent Statements

The study protocol was reviewed and approved by İzmir Bakircay University, Faculty of Medicine. This study was conducted in accordance with the tenets of the Declaration of Helsinki. All participants provided informed consent to participate in the study, which was approved by the local institutional ethics committee.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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The authors report no conflicts of interest in this work.

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