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Effect of Surgicel Application on Adhesion Formation to the Uterine Scar Following Cesarean Section

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Abstract

Background: Post-cesarean adhesions are a major cause of operative difficulty, pelvic pain, and infertility. *Surgicel* (oxidized regenerated cellulose) is frequently used for intraoperative hemostasis, but its role in adhesion formation remains controversial. **Objective:** To assess the effect of Surgicel application on the incidence and severity of postoperative adhesions at the uterine scar after cesarean section. **Methods:** A prospective cohort study was conducted at Saudi National Hospital, Makkah, between January and October 2024. Sixty women undergoing cesarean section were enrolled—30 received Surgicel on the uterine incision (Surgicel group), and 30 underwent standard closure (control). Adhesion formation was evaluated at follow-up surgery or imaging ≥6 months postoperatively using the modified Nair Adhesion Scoring System. **Results:** Adhesions were observed in 66.7% of the Surgicel group versus 33.3% of controls ($p = 0.01$). The mean adhesion extent (35% vs. 18%) and tenacity score (3.5 vs. 2.1) were significantly higher with Surgicel. Omental adhesions were the most common type observed. **Conclusion:** Surgicel, although effective for hemostasis, may increase postoperative adhesion formation at the uterine scar. Surgeons should balance hemostatic benefit against adhesion risk during cesarean section.

Keywords

Surgicel, Cesarean Section, Postoperative Adhesion, Omental Adhesion, Uterine Scar, Oxidized Regenerated Cellulose

1. Introduction

Cesarean section (CS) is among the most frequently performed obstetric procedures

worldwide. Despite its safety, postoperative adhesions remain a significant long-term complication, affecting fertility, causing chronic pelvic pain, and complicating future abdominal surgeries [1]. Adhesions arise from normal peritoneal wound healing involving inflammation, fibroblast activation, and collagen deposition [2].

Hemostatic agents such as *Surgicel* (oxidized regenerated cellulose, ORC) are commonly used to control bleeding during surgery. Surgicel acts as a physical matrix promoting platelet aggregation and clot formation, and it is fully biodegradable. However, animal and human studies suggest that ORC may cause local inflammation and fibrosis, potentially promoting adhesion formation [3] [4].

The literature remains inconclusive: some studies report increased adhesion risk with Surgicel [5] [6], while others find no significant association [7] [8]. Given the global increase in cesarean deliveries and the lack of focused data on uterine scar adhesions, this study aims to evaluate the effect of Surgicel on adhesion incidence, extent, and tenacity at the uterine incision site after cesarean section.

2. Materials and Methods

2.1. Study Design

This prospective cohort study was performed at the Department of Obstetrics and Gynecology, Saudi National Hospital, Makkah, between January 2024 and October 2024.

2.2. Ethical Considerations

The study was approved by the Saudi National Hospital Research Ethics Committee (Approval No. SNH/OBG/2024/011). All participants provided written informed consent prior to inclusion.

2.3. Participants

Women aged 18 - 40 years scheduled for elective or emergency CS were eligible. Exclusion criteria included previous pelvic inflammatory disease, prior pelvic radiation, coagulation disorders, or known allergy to ORC materials.

Participants were divided into two groups (n = 30 each):

- **Surgicel group:** Application of Surgicel over the uterine incision before peritoneal closure.
- **Control group:** Standard hemostasis without Surgicel.

2.4. Surgical Technique

All operations were performed by experienced obstetricians using a standardized lower-segment transverse incision. Conventional methods ensured hemostasis in both groups; only the Surgicel group received additional application of ORC. The peritoneum and fascia were closed in layers.

2.5. Follow-Up and Assessment

Patients were followed for at least six months post-CS. Adhesion formation was

evaluated either during repeat surgery or by imaging (MRI or high-resolution ultrasound with cine sequences). The modified Nair Adhesion Scoring System was used to classify adhesions by extent (percentage of uterine scar involved) and tenacity (adhesion strength). Two independent observers (surgeon and radiologist) blinded to patient allocation performed the assessments.

2.6. Statistical Analysis

Data were analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation and compared using Student's *t*-test. Categorical data were compared using the Chi-square test. A p-value < 0.05 was considered statistically significant.

3. Results

3.1. Baseline Characteristics

There were no significant differences between groups regarding age, parity, or indication for CS (Table 1).

Table 1. Baseline characteristics of study participants.

Parameter	Surgicel Group (n = 30)	Control Group (n = 30)	p-value
Age (years)	29.8 ± 4.2	30.2 ± 3.8	0.68
Parity (median)	2	2	0.90
Elective CS (%)	40	43	0.81

3.2. Adhesion Outcomes

Adhesions were detected in 20 patients (66.7%) in the Surgicel group and 10 (33.3%) in controls ($p = 0.01$).

The mean adhesion extent was 35% ± 10% versus 18% ± 8% ($p = 0.02$), and adhesion tenacity scores were 3.5 ± 0.8 versus 2.1 ± 0.6 ($p = 0.01$).

Omental adhesions were most frequently observed (14 vs. 7 patients).

These findings indicate that Surgicel use was significantly associated with both increased incidence and severity of adhesions.

4. Discussion

This study demonstrated that the intraoperative use of Surgicel on the uterine incision during cesarean section significantly increased the incidence, extent, and strength of postoperative adhesions. These findings align with earlier reports that oxidized regenerated cellulose materials can trigger fibroblast proliferation, collagen deposition, and a sustained inflammatory response [4] [5].

Possible mechanisms:

Surgicel may act as a foreign body, delaying peritoneal healing and causing lo-

calized fibrin deposition [3] [6]. As fibrin persists, it serves as a scaffold for fibroblast migration and vascular proliferation, leading to dense fibrous adhesions [2]. Additionally, incomplete degradation of ORC can perpetuate mild inflammation, amplifying adhesion risk [5].

Comparison with literature:

Gao *et al.* [3] found increased peritoneal fibrosis in rats treated with Surgicel compared to controls, supporting our findings. Similarly, Al-Tarakji *et al.* [5] observed a higher incidence of pelvic adhesions after gynecologic surgery involving Surgicel. In contrast, Becker *et al.* [7] reported no significant difference, possibly due to differences in exposure time and surgical environment. Holmdahl *et al.* [8] also suggested that rapid ORC absorption (within 7 - 14 days) may limit long-term fibrotic response, but this may vary with application site and tissue vascularity.

Clinical implications:

Adhesion formation after cesarean section poses challenges during repeat operations, including increased operative time, risk of bowel or bladder injury, and reduced fertility potential [1] [9]. Our findings underscore the need for cautious use of hemostatic agents on the uterine incision, especially in women with multiple prior CS or future pregnancy plans.

Study limitations:

The sample size was modest, and follow-up imaging may underestimate subclinical adhesions. Histopathologic confirmation was not performed. Larger randomized trials with longer follow-up and biochemical evaluation of fibrosis are recommended.

5. Conclusion

The use of Surgicel during cesarean section is associated with a significantly higher rate and severity of postoperative adhesions at the uterine scar, particularly involving the omentum. While Surgicel remains an effective hemostatic agent, its use on the uterine incision should be carefully considered. Alternative hemostatic methods or anti-adhesion barriers may be preferred in patients at high risk for repeat abdominal surgeries.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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