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A Comparative Study of Conventional Nasal Packing and Merocel Nasal Packing Following Endoscopic Sinus Surgery.

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Abstract

Background: Endoscopic sinus surgery (ESS) is the gold standard surgical intervention for medically refractory chronic rhinosinusitis (CRS). Postoperative nasal packing is frequently utilized to control hemorrhage, support the middle turbinate, and prevent synechiae formation. However, the choice of packing material remains a subject of ongoing debate. ***Objective:*** This study aims to compare the clinical outcomes, patient comfort, and postoperative complications associated with conventional ribbon gauze nasal packing versus Merocel (polyvinyl acetate) packing following ESS. ***Materials and Methods:*** A prospective, randomized, comparative clinical study was conducted on 120 patients undergoing bilateral ESS for CRS with or without nasal polyposis. Patients were randomly assigned to receive either conventional antibiotic-soaked ribbon gauze (Group A, n=60) or Merocel packing (Group B, n=60). The primary outcome measures included postoperative pain, nasal obstruction, headache, and pain during pack removal, assessed using a Visual Analogue Scale (VAS). Secondary outcomes included bleeding upon pack removal, mucosal trauma, and the incidence of synechiae formation at 1, 4, and 12 weeks postoperatively, assessed via diagnostic nasal endoscopy. ***Results:*** Patients in Group B (Merocel) reported significantly lower VAS scores for headache and facial pressure while the packing was in situ compared to Group A (Conventional). Pain during packing removal was significantly higher in Group A (7.8 ± 1.2) than in Group B (4.3 ± 1.5) ($p < 0.001$). Bleeding upon removal was also notably higher in the conventional group. Long-term endoscopic follow-up revealed a higher incidence of synechiae formation in the conventional group (18.3%) compared to the Merocel group (6.6%) ($p < 0.05$). ***Conclusion:*** Merocel nasal packing is significantly superior to conventional ribbon gauze packing in terms of patient comfort, ease of removal, reduced mucosal trauma, and a lower incidence of postoperative synechiae. While conventional packing is highly cost-effective, the morbidity associated with its use makes Merocel a preferable alternative in modern rhinologic practice.

Keywords: Endoscopic Sinus Surgery, FESS, Nasal Packing, Merocel, Chronic Rhinosinusitis, Synechiae, Visual Analogue Scale, Epistaxis.

INTRODUCTION

Background of Endoscopic Sinus Surgery

Chronic rhinosinusitis (CRS), defined as the inflammation of the nose and paranasal sinuses lasting for more than 12 weeks, is one of the most prevalent chronic healthcare conditions globally. It significantly diminishes patients' quality of life, impacting them physically, functionally, and emotionally. When maximal medical therapy comprising topical and systemic corticosteroids, saline irrigations, and appropriately targeted antibiotics-fails to alleviate symptoms, surgical intervention becomes the primary recourse. [1]

Functional Endoscopic Sinus Surgery (FESS) or Endoscopic Sinus Surgery (ESS) has revolutionized the surgical management of CRS over the past three decades. Championed by Messerklinger and Stammberger, the philosophy of ESS centers on re-establishing sinus ventilation and mucociliary clearance by targeting the osteomeatal complex while preserving normal sinus mucosa and anatomical structures. [2]

The Role of Postoperative Nasal Packing

Despite the minimally invasive nature of ESS, postoperative care is critically important to achieve a successful surgical outcome. The denuded mucosal surfaces, exposed bone, and raw edges of the middle turbinate are prone to postoperative bleeding, crusting, and abnormal healing. A well-known complication of ESS is the lateralization of the middle turbinate,

which can adhere to the lateral nasal wall, creating synechiae (scar bands). Synechiae can obstruct the newly opened sinus ostia, leading to surgical failure and symptom recurrence. [3]

To mitigate these complications, rhinologists have traditionally employed nasal packing at the conclusion of the surgery. The ideal nasal packing should achieve several objectives:

1. Provide adequate hemostasis to prevent primary and secondary postoperative epistaxis.
2. Act as a middle meatal spacer to stabilize the middle turbinate and prevent its lateralization.
3. Prevent synechiae formation by keeping raw mucosal surfaces separated during the initial phases of wound healing.
4. Be easily insertable and removable without causing additional mucosal trauma.
5. Be comfortable for the patient, minimizing pain, headache, and obstruction.
6. Be cost-effective and readily available. [3,4]

Evolution of Packing Materials

Historically, nasal packing consisted of yards of continuous ribbon gauze impregnated with substances like Bismuth Iodoform Paraffin Paste (BIPP), liquid paraffin, or antibiotic ointments. While highly effective at tamponading bleeding vessels through direct mechanical pressure, conventional ribbon gauze is notoriously uncomfortable. Its removal is frequently described by patients as the most painful aspect of the entire surgical experience, often inducing intense pain, vasovagal attacks, and significant secondary bleeding due to the stripping of the newly formed fibrin clot and regenerating respiratory epithelium.

In an effort to reduce patient morbidity, various synthetic biomaterials have been introduced. Merocel, a highly biocompatible, non-absorbable synthetic sponge made of hydroxylated polyvinyl acetate, is among the most widely used. In its dehydrated state, Merocel is rigid and compressed, allowing for easy, atraumatic insertion into the nasal cavity. Upon contact with blood or saline, it absorbs the fluid and rapidly expands, conforming to the contours of the nasal cavity. This provides a gentle, uniform, and continuous radial pressure that is theoretically less traumatic than the uneven pressure exerted by manually layered ribbon gauze. [4,5]

Rationale of the Study

Despite the theoretical advantages of Merocel and the advent of newer, fully absorbable packing materials (such as Nasopore or hyaluronic acid-based gels), conventional ribbon gauze and Merocel remain the most frequently utilized packing materials in developing and newly industrialized nations due to economic constraints.

There remains a significant disparity in the literature regarding the true objective benefits of Merocel over conventional packing, particularly concerning long-term mucosal healing and the exact degree of patient discomfort. Therefore, this prospective randomized comparative study was designed to systematically evaluate and compare the efficacy, patient tolerance, and postoperative complications associated with conventional ribbon gauze versus Merocel nasal packing following endoscopic sinus surgery.

MATERIALS AND METHODS

Study Design and Setting

This was a prospective, randomized, comparative, single-blind clinical trial conducted at the Department of Otorhinolaryngology and Head & Neck Surgery at a tertiary care medical center over a period of 24 months. The study protocol was approved by the Institutional Ethics Committee, and written informed consent was obtained from all participating subjects prior to enrollment.

Study Population

A total of 120 adult patients diagnosed with chronic rhinosinusitis (with or without nasal polyposis) who were scheduled for elective bilateral Endoscopic Sinus Surgery were enrolled in the study.

Inclusion Criteria:

- Patients aged between 18 and 65 years.
- Diagnosis of CRS confirmed by clinical history, diagnostic nasal endoscopy, and a computed tomography (CT) scan of the paranasal sinuses, adhering to the EPOS (European Position Paper on Rhinosinusitis and Nasal Polyps) criteria.
- Failure of maximal medical therapy for at least 3 months.
- Lund-Mackay CT score > 12.

Exclusion Criteria:

- Patients undergoing concomitant septoplasty or rhinoplasty (to eliminate confounding variables related to septal pain and bleeding).

- History of previous sinus surgery (revision ESS).
- Known bleeding diathesis, coagulopathies, or patients on anticoagulant/antiplatelet therapy that could not be temporarily halted.
- Presence of extensive sinonasal tumors, fungal rhinosinusitis requiring aggressive debridement, or massive polyposis requiring extensive modifications of the standard ESS technique.
- Pregnancy or lactation.

Randomization and Allocation

The 120 patients were randomized into two parallel groups using a computer-generated random number table. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes.

- **Group A (Conventional Packing):** Comprised 60 patients who received bilateral continuous ribbon gauze packing (impregnated with a combination of liquid paraffin and mupirocin ointment).
- **Group B (Merocel Packing):** Comprised 60 patients who received bilateral standard 8 cm Merocel nasal tampons (Medtronic Xomed, Jacksonville, FL, USA).

Because of the visible differences in the packing materials protruding from the nostrils, blinding the operating surgeon and the patient was not possible. However, the statistician analyzing the data and the independent rhinologist conducting the postoperative endoscopic evaluations at 4 and 12 weeks were blinded to the initial packing allocation.

Surgical Procedure

All surgical procedures were performed under general anesthesia with controlled hypotension to minimize intraoperative bleeding. The surgeries were conducted by the same team of experienced rhinologists to eliminate technique-related biases.

The standard Messerklinger technique was employed. After mucosal decongestion with topical adrenaline (1:100,000) on neurosurgical patties, uncinectomy was performed. The natural ostium of the maxillary sinus was identified and widened (middle meatal antrostomy). Anterior and posterior ethmoidectomies, sphenoidotomies, and frontal sinus recess clearances were performed as dictated by the extent of the disease indicated on the preoperative CT scan. Hemostasis during the procedure was achieved using topical adrenaline and, rarely, bipolar electrocautery.

At the conclusion of the procedure, packing was inserted:

- **Group A:** A 2-meter ribbon gauze soaked in paraffin and mupirocin was gently layered into the ethmoid cavity and the middle meatus, extending down to the floor of the nasal cavity on both sides.
- **Group B:** An 8 cm Merocel sponge, thinly coated with a layer of antibiotic ointment to reduce tissue adherence, was inserted along the floor of the nasal cavity and into the middle meatus. The Merocel was then hydrated in situ with 5 mL of sterile 0.9% normal saline per side to ensure full expansion.

Postoperative Protocol and Pack Removal

Patients were observed in the surgical ward for 48 hours. Postoperative medical management included intravenous broad-spectrum antibiotics, systemic analgesics (acetaminophen and ibuprofen), and saline nebulization.

The nasal packs were removed 48 hours postoperatively in the treatment room. No systemic sedatives were given prior to removal. For Group B, the Merocel packs were rehydrated with 10 mL of normal saline 10 minutes prior to removal to soften any adherent blood clots and ease the extraction process. The conventional gauze was removed in a slow, continuous motion.

Following pack removal, patients were instructed to perform high-volume, low-pressure nasal saline irrigations (240 mL twice daily) and were discharged on a 7-day course of oral antibiotics.

Outcome Measures and Assessment Tools

Data were collected at multiple time points: in situ (first 48 hours), during removal, and during follow-up visits (1, 4, and 12 weeks post-surgery).

1. Subjective Symptoms (Assessed via 10-point Visual Analogue Scale - VAS):

Where 0 represents no symptom/pain, and 10 represents the worst imaginable symptom/pain.

- Pain in situ: Assessed at 12, 24, and 48 hours postoperatively.
- Headache and Facial Pressure: Assessed at 24 and 48 hours.
- Nasal Obstruction & Epiphora (Tearing): Assessed at 24 hours.
- Pain on Removal: Assessed immediately after the extraction of the packing.

2. Objective Signs (Assessed by the Physician):

- **Bleeding on Removal:** Graded on a 4-point scale:
- Grade 0: No bleeding.
- Grade 1: Mild oozing, stopping spontaneously within 5 minutes.
- Grade 2: Moderate bleeding requiring topical vasoconstrictors.
- Grade 3: Severe bleeding requiring repacking or cauterization.
- **Mucosal Healing and Synechiae:** Evaluated using the Lund-Kennedy Endoscopic Scoring system by a blinded rhinologist at 1, 4, and 12 weeks. Specific attention was given to the presence of middle meatal synechiae (adhesions), crusting, and granulation tissue.

Statistical Analysis

Data were tabulated using Microsoft Excel and analyzed using SPSS software (Version 25.0, IBM Corp., Armonk, NY, USA). Continuous variables (e.g., age, VAS scores) were presented as Mean ± Standard Deviation (SD) and compared using the independent samples t-test. Categorical variables (e.g., gender, grades of bleeding, presence of synechiae) were expressed as frequencies and percentages and compared using the Chi-square (χ^2) test or Fisher's exact test, as appropriate. A p-value of < 0.05 was considered statistically significant, and < 0.001 as highly significant.

RESULTS

Demographic Data

A total of 120 patients completed the study without any loss to follow-up. The baseline demographic and clinical characteristics of the patients were comparable between the two groups, ensuring no preoperative bias. The mean age was 38.4 ± 11.2 years in Group A and 37.9 ± 10.8 years in Group B. There was a slight male predominance in both groups (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Group A (Conventional) (n=60)	Group B (Merocel) (n=60)	p-value
Age (years, mean ± SD)	38.4 ± 11.2	37.9 ± 10.8	0.81
Gender (Male/Female)	34 / 26	32 / 28	0.71
Pre-op Lund-Mackay Score	15.2 ± 3.1	14.9 ± 3.4	0.62
Operative Time (minutes)	82.5 ± 14.3	80.2 ± 12.8	0.36

Subjective Symptoms with Packing In Situ

During the 48 hours the packing remained in the nasal cavity, patients in Group A experienced significantly higher morbidity. The mean VAS score for pain while the packing was in situ was substantially higher in the conventional group.

At 24 hours, the mean pain score for Group A was 6.5 ± 1.4, compared to 4.2 ± 1.1 for Group B ($p < 0.001$). Similarly, headache and facial pressure were notably worse in the ribbon gauze group. Epiphora, caused by the mechanical obstruction of the nasolacrimal duct by the packing material, was reported by 45% of patients in Group A, but only 15% in Group B ($p < 0.01$).

Table 2: Subjective Symptom VAS Scores (Mean±SD) In Situ

Symptom (VAS 0-10)	Group A (Conventional)	Group B (Merocel)	p-value
Nasal Pain (at 24h)	6.5 ± 1.4	4.2 ± 1.1	< 0.001
Headache (at 24h)	5.8 ± 1.6	3.5 ± 1.3	< 0.001
Nasal Obstruction	8.9 ± 0.8	8.6 ± 0.9	0.06 (NS)
Sleep Disturbance	7.2 ± 1.5	4.8 ± 1.2	< 0.001

(NS = Not Significant)

Morbidity During Pack Removal

The act of removing the nasal packing elicited the most significant differences between the two modalities. The conventional ribbon gauze group (Group A) reported severe distress upon removal.

- **Pain on Removal:** The mean VAS score for pain during extraction in Group A was 8.2 ± 1.1, characterizing severe, sharp pain. In contrast, Group B experienced a mean VAS score of 4.1 ± 1.3 ($p < 0.001$).

- **Bleeding on Removal:** Mucosal stripping and subsequent bleeding were profound in Group A. 30% of patients in Group A experienced Grade 2 bleeding, and 8.3% experienced Grade 3 bleeding requiring topical vasoconstrictors and localized repacking. In Group B, 75% of patients had only Grade 0 or Grade 1 bleeding, which ceased spontaneously. None of the patients in the Merocel group experienced Grade 3 bleeding.

Table 3: Bleeding Severity Upon Pack Removal

Grade of Bleeding	Group A (Conventional) (n=60)	Group B (Merocel) (n=60)	p-value
Grade 0 (None)	6 (10%)	18 (30%)	< 0.01
Grade 1 (Mild)	31 (51.7%)	38 (63.3%)	0.23
Grade 2 (Moderate)	18 (30%)	4 (6.7%)	< 0.001
Grade 3 (Severe)	5 (8.3%)	0 (0%)	< 0.05

Postoperative Mucosal Healing and Late Complications

Blinded endoscopic evaluations were carried out to assess the quality of mucosal healing. At the 1-week follow-up, both groups exhibited significant crusting and fibrin exudates, though it was visually more pronounced in Group A.

By the 4-week follow-up, the incidence of synechiae formation (particularly between the lateral surface of the middle turbinate and the lateral nasal wall) began to diverge. At the final 12-week follow-up, 11 patients (18.3%) in Group A demonstrated established middle meatal synechiae, compared to only 4 patients (6.6%) in Group B ($p = 0.04).

Furthermore, prolonged mucosal edema and persistent granulation tissue were more frequently observed in the ribbon gauze group at 12 weeks, indicating a delayed healing cascade secondary to the initial mechanical trauma inflicted during packing removal.

DISCUSSION

The advent of Endoscopic Sinus Surgery shifted the paradigm of sinus disease management from aggressive mucosal stripping to functional, mucosa-sparing procedures. Consequently, the postoperative care regimen-specifically the nature of the nasal packing-must align with this tissue-preserving philosophy. The primary goal of this study was to compare conventional ribbon gauze, which remains widely used due to its negligible cost, with Merocel, a specialized biomaterial, to ascertain if the clinical benefits of the latter justify its routine use.

Hemostasis and Intra-cavity Mechanics

The mechanism by which conventional ribbon gauze achieves hemostasis relies entirely on brute mechanical compression. By layering meters of gauze into the rigid bony confines of the nasal cavity, significant pressure is exerted on the bleeding vessels. However, this pressure is inherently unequal.[6] As demonstrated in our study, this leads to intense localized ischemic pressure on the sensitive nasal mucosa and the delicate structures of the middle meatus.

Merocel, composed of hydroxylated polyvinyl acetate, functions differently. In its dehydrated state, it is easily manipulated. Upon hydration via blood or applied saline, the sponge expands isotropically (equally in all directions). This provides a uniform, compliant, and gentle radial pressure against the nasal walls.[6] Our clinical findings support this physical property: patients in the Merocel group reported significantly lower scores for headache, facial pressure, and general in situ pain ($p < 0.001$). The uniform expansion of Merocel conforms to the unique anatomy of the ethmoid cavity without applying the pinpoint crushing pressure typical of layered gauze.

The Trauma of Removal

The most dreaded aspect of traditional sinus surgery for the patient is the removal of the nasal packing. Our data starkly highlights this phenomenon. The mean VAS for pain during removal in the conventional group was 8.2 ± 1.1, categorized as severe pain. Ribbon gauze, particularly when impregnated with ointments that dry out over 48 hours, acts as a scaffold for fibrin and clot formation. The microscopic fibers of the cotton gauze become physically intertwined with the regenerating respiratory epithelium. When the continuous ribbon is pulled out, it inevitably strips away this newly formed mucosal layer, leaving raw, bleeding surfaces.

This is objectively reflected in our bleeding scores. A total of 38.3% of patients in the conventional group experienced moderate to severe (Grade 2 or 3) bleeding upon removal, compared to only 6.7% in the Merocel group. The Merocel sponge, particularly when lightly coated with an antibiotic ointment prior to insertion and thoroughly rehydrated 10 minutes

prior to removal, maintains a smoother interface with the mucosa. The hydration causes the sponge to become soft and pliable, allowing it to glide out of the nasal cavity with minimal friction.

These findings are highly consistent with the literature. Pranoto AE et al. (2026) demonstrated that synthetic sponges resulted in statistically significant reductions in extraction pain and secondary bleeding when compared to traditional gauze.[7] Similarly, Mohite P. et al. (2014) reviewed the importance of technologies adapted in fabrication of hydrogel spones, application of various polymers in fabrication, characterization of hydrogel sponge using different physiochemical and analytical techniques, and its biomimetic action and concluded that rehydration of polyvinyl acetate sponges, noting that dry extraction of Merocel can cause trauma comparable to gauze; however, adequate saline soaking prior to removal virtually eliminates this risk, a protocol strictly adhered to in our methodology.[8]

Long-term Mucosal Healing and Synechiae Formation

Beyond immediate postoperative comfort, the ultimate success of ESS hinges on optimal mucosal healing. The formation of middle meatal synechiae is a primary cause of ESS failure, as scar tissue can obstruct the maxillary and ethmoid ostia, leading to recurrent sinus infections and the need for revision surgery.

Our blinded 12-week endoscopic evaluations revealed a statistically significant reduction in synechiae formation in the Merocel group (6.6%) compared to the conventional group (18.3%). The pathophysiology behind this difference is directly linked to the mucosal trauma inflicted during pack extraction. The epithelial stripping caused by the ribbon gauze leaves opposing raw mucosal surfaces (e.g., the medial aspect of the middle turbinate and the lateral nasal wall).

During the inflammatory phase of wound healing, fibrin cross-linking between these opposing raw surfaces creates a bridge, which eventually organizes into fibrous scar tissue-a synechia.[9]

Because Merocel removal results in significantly less mucosal denudation, the integrity of the epithelial lining is largely preserved.[10] Intact epithelium cannot fuse with opposing intact epithelium, thereby halting the pathogenesis of synechiae. Furthermore, the uniform physical presence of the Merocel sponge in the first 48 hours acts as an excellent mechanical spacer, actively lateralizing the middle meatal structures and physically blocking the immediate postoperative fibrinous adhesions that precede true synechiae.[11]

Cost-Benefit Analysis and Clinical Implications

A critical aspect of clinical decision-making, particularly in resource-limited settings, is cost-effectiveness. Conventional ribbon gauze is extremely inexpensive. However, the true "cost" of a medical intervention must include patient morbidity, nursing time, and the treatment of complications.

The severe pain and moderate-to-severe bleeding associated with ribbon gauze removal often necessitate prolonged hospital stays, the use of topical hemostatic agents, occasional repacking, and increased utilization of analgesics. Furthermore, the higher rate of synechiae formation (18.3%) implies a higher potential need for postoperative outpatient debridements or even revision surgeries.

When these downstream costs are factored in, the initial higher cost of a Merocel tampon is comfortably offset by the rapid, atraumatic removal process, early discharge, improved patient satisfaction, and superior long-term surgical outcomes.

Limitations of the Study

While this study provides robust data, certain limitations must be acknowledged. First, absolute double-blinding was impossible due to the distinct visual appearances of the packing materials protruding from the nasal vestibule, which may introduce a degree of subjective bias in patient reporting, though the endpoints were clear. Second, the study did not compare Merocel with the newer generation of absorbable packing materials (such as Nasopore or gelatin-thrombin matrix), which do not require removal at all. Future multicenter studies incorporating these absorbable materials would provide a more complete spectrum of postoperative care options.

CONCLUSION

Postoperative nasal packing remains a vital component of successful Endoscopic Sinus Surgery, ensuring hemostasis and structural support for the healing ethmoid cavity. The findings of this prospective, randomized study unequivocally demonstrate the clinical superiority of Merocel over conventional ribbon gauze packing.

Merocel provides excellent hemostatic control while significantly reducing patient morbidity in terms of in situ headache, pain, and facial pressure. Crucially, the removal of Merocel is markedly less traumatic than ribbon gauze, resulting in dramatically less pain and minimal secondary bleeding. By preserving the integrity of the delicate regenerating respiratory

mucosa, Merocel significantly decreases the incidence of postoperative synechiae, thereby promoting superior long-term surgical outcomes and reducing the likelihood of disease recurrence.

While conventional ribbon gauze is undeniably cheaper in raw material costs, the hidden costs associated with its complications and the severe physical distress it inflicts upon patients render it obsolete in modern rhinologic practice. Therefore, we strongly recommend the use of Merocel (or equivalent biomaterials) as the standard of care for non-absorbable nasal packing following endoscopic sinus surgery.

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