ORIGINAL ARTICLE

Clinical outcome and patient satisfaction using biodegradable (NasoPore) and non-biodegradable packing, a double-blind, prospective, randomized study

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KEYWORDS
FESS surgery; Biodegradable packing; Patient satisfaction; Mucosal healing; Follow-up

Abstract

Introduction: Nasal packing after endoscopic sinus surgery is used as a standard procedure. The optimum solution to minimize or eliminate all disadvantages of this procedure may be accomplished using biodegradable packs.

Objective: The aim of this study was to compare patient satisfaction and clinical outcome associated with absorbable and non-absorbable packing after FESS.

Methods: In total, 50 patients were included in a prospective, double-blind, randomized trial. One side was packed with polyurethane foam, while the opposite side was packed with gauze packing. On the 2nd, 10th, and 30th postoperative day, the patients were questioned with the aid of a visual analog scale. The standardized questionnaires for bleeding, nasal breathing, feeling of pressure, and headache were used. The presence of synchiae, infection, or granulation was noted and recorded with the video-endoscopy.

Results: A significant difference according to lower pressure was found in the NasoPore group compared to the controls on day ten after surgery. The NasoPore packing had lower scores with respect to postoperative nose blockage on the 2nd and 10th days. Mucosal healing was better for the NasoPore group, both at day ten and 30 compared with the control group.


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Introduction

Chronic rhinosinusitis is a very common disease, and the success of treatment is dependent on effective surgery and postoperative care. Endoscopic sinus surgery (ESS) has become the gold standard for the treatment of inflammatory, benign and selected malignant pathology. The main principles are re-establishing ventilation and drainage without scarring, synechiae, and obstruction. To achieve these results, the middle meatus is often packed. This procedure should stabilize the middle turbinate, prevent synechiae formation, and act as a hemostatic agent. However, nasal packing can be a source of pain, nasal obstruction, bleeding, and discomfort during pack removal. These disadvantages are mostly compared with non-absorbable nasal packing.

Recently, different absorbable biomaterials have become available for use as middle meatus packing after functional endoscopic sinus surgery (FESS). These kinds of packs do not need to be removed and therefore improve patient comfort after surgery. The material prevents synechiae formation and stabilizes the middle turbinate. It starts to dissolve within a few days and can be washed out or suctioned from the nose.

NasoPore (Polyganics – Groningen, The Netherlands) is a biodegradable synthetic polyurethane foam, which was used in the current work. The polyurethane bonds provide strong initial compressive mechanical properties, whereas the hydrophilic component takes-up the water or blood and is gradually fragmented. The aim of this study was to compare patient satisfaction and clinical outcome associated with the absorbable and non-absorbable packing after FESS.

Methods

Study design

A prospective, double-blind, randomized trial; one side was packed with polyurethane foam after bilateral sinus
surgery while the opposite side was filled with packing composed of traditional impregnated gauze strip. This study was approved by the Bioethics Committee of the Nicolaus Copernicus University (KB 326/2013) and written informed consent was obtained from all participants.

A total of 50 patients were included from the Dep. of Otolaryngology and Laryngological Oncology. The mean age was 47.5 years (±9.8); 22 female and 28 male patients were included. The inclusion criteria were chronic rhinosinusitis (CRS) with or without nasal polyps according to the EPOS guidelines\(^1\) and symmetrical pathology between the nasal cavities based on computed tomography (CT) scan.\(^2\) The study included 38 patients with CRS with nasal polyps and 12 without nasal polyps. The exclusion criteria were septoplasty, turbinate surgery, or known intolerance to polyurethane. In each case, bilateral surgery was performed to the same extent. The research was approved by the local ethics committee and informed consent was obtained before the study. The patients were computer-randomized to packing the right or left side with NasoPore and the other side with gauze strip. In all cases, the packing was placed in the middle meatus at the end of the surgery.

**Surgery**

The surgery was performed under general anesthesia by one surgeon. To minimize bleeding and optimize the surgical field, the procedure used premedication with clonidine and total intravenous anesthesia (TIVA), as described previously.\(^3\) Preoperatively, all of the patients received intravenous antibiotics (cefuroxime 1.5 g). At the end of the surgery, the surgeon was informed by the nurse of which side to use the NasoPore, which was randomly assigned. The opposite side was packed with non-resorbable gauze strip pack. Standard 4 cm NasoPore and 4 cm long gauze strip with an ointment (Fig. 1) were used. The procedure utilized 2 g Oxyct ointment (1 g contains 310 mg of hydrocortisone and 30 mg of oxytetracycline, as well as the base – Jella, Poland). The patients and the observer were not informed of which side had received the NasoPore or gauze packing.

![Figure 1](image.png)

**Table 1** Results of visual analog scale questionnaire during the follow-up visits.

<table>
<thead>
<tr>
<th>Day</th>
<th>Pressure</th>
<th>Headache</th>
<th>Nasal pain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>C</td>
<td>P</td>
</tr>
<tr>
<td>2</td>
<td>3.03 (±3.01)</td>
<td>3.26 (±2.93)</td>
<td>0.15</td>
</tr>
<tr>
<td>10</td>
<td>1.9 (±1.93)</td>
<td>2.16 (±1.99)</td>
<td>0.04</td>
</tr>
<tr>
<td>30</td>
<td>2.43 (±0.58)</td>
<td>0.45 (±1.22)</td>
<td>0.06</td>
</tr>
<tr>
<td>49</td>
<td>0.4 (±0.78)</td>
<td>0.4 (±0.78)</td>
<td>0.49</td>
</tr>
</tbody>
</table>

N, NasoPore; C, control; n, number of patients.
Follow-up

On the 2nd, 10th, and 30th postoperative day, a physician other than the operating surgeon questioned the patients with the aid of a visual analog scale (VAS) and performed nasal endoscopy. The non-absorbable packing was removed on the 10th day after surgery. The data collection was analogous to comparable studies, using standardized questionnaires for each side for the following parameters: bleeding, nasal breathing, feeling of pressure, and headache. The parameters were determined using a VAS with possible values ranging from 0 (no symptoms) to 10 (maximum symptoms). The presence of synechiae, infection, granulation, or re-epithelialization was noted and recorded with the video-endoscopy on both sides on the 10th and 30th day after surgery. After discharge, all patients used an antibiotic (clarithromycin, 1000 mg daily for 10 days, nasal steroids (fluticasone furoate) once daily, and nasal saline douches up to three to four times daily).

Statistical analysis

Statistical analysis was performed with Statistica software, v. 10. (StatSoft Inc.) The parameters were compared using the Wilcoxon signed rank test, McNemara test, and Shapiro–Wilk’s test. The level of significance was defined as $p < 0.05$. The study population was calculated for error inherent in a test result. The power analysis of the investigation group was 80%.

Results

Fifty patients were randomized and 100 sinus cavities were treated. The absorbable packing was put in 27 right sides and 23 left sides of the nasal cavities. The non-absorbable packing was put accordingly in 23 right and 27 left sides of the nasal cavities. Forty-nine patients completed the study. This was due to one patient refusing to attend follow-up, as he felt well. The VAS results for pressure, nose blockage, headache, and nasal pain are shown in Table 1. A significant difference according to pressure was found between the NasoPore and control sides on day 10 after surgery ($p < 0.04$). The patients reported lower filling of nose pressure on the NasoPore side. No differences were observed on the 2nd and 30th days post-surgery. The NasoPore packing had lower scores with respect to postoperative nose blockage (4.26 vs. 4.73, $p < 0.04$) on the 2nd and 10th days (1.81 vs. 2.29, $p < 0.02$; Table 1). The results were significant. However, there was no significance on the 30th day (0.45 vs. 0.68, ns). Nevertheless, slightly lower scores for headache and nasal pain were recorded for the NasoPore group during the follow-up visits, but the results were not significant (Table 1).

Assessment of bleeding on packing removal demonstrated no differences. Minimal bleeding without any future intervention was observed for one case in each group. Forty-nine subjects returned for the assessment of mucosal healing on the 10th and 30th days after operation. Endoscopic observations of wound healing after surgery revealed blood crusting, edematous swelling, and epithelialization. Mucosal healing (re-epithelialization) was better for

Figure 2  NasoPore at the end of surgery (A) and resorption process at 2nd, 10th, and 30th day (B–D), as well as some remnants of dressing after ten days post operation (E) and synechia formation (F).
the NasoPore group, both on day ten and 30, compared with

the control group (p < 0.001, \(p < 0.06\)). At 10th day the re-

epithelization in study group was 68.1% and reached over

95.7% at 30th day. The endoscopic view at 10th day was

very satisfactory compared to control group, where only

32.7% of the operated field showed epithelization. In both
groups at the 30th day, the re-epithelization level was over

90%, pointing to complete healing. Nevertheless, the re-

epithelization in the control group achieved a satisfactory

level on the 30th day (90.2%). In this study, synchiae formation

was observed in three of the NasoPore group and two of the

control group (Fig. 2). No significance was observed
(Table 2). In one case of non-absorbable packing, on the 30th
day of follow-up, infection with mucopurulent discharge was

found.

Resorption of the absorbable packing was fluent in most
cases (Fig. 2). In three cases, some remnants of the dressing

on the 10th day were noted, which could result in synchiae formation in the late follow-up (Fig. 2). In these cases, the

patients did not adhere to the recommendation of regular
(three to four times per day) nasal douches.

Discussion

The most important considerations after FESS operations are patient comfort, minimizing bleeding, reduction of dis-

comfort associated with nasal packing, and proper mucosal healing. As the non-resorbable (removable) nasal packing

can be very unpleasant, the different types of resorbable packing have been investigated.4–6,8,10 Some authors do not

support the use of nasal packing at all.5,8,10,15 Conversely, middle meatal packing has prevented lateralization of the

middle turbinate, synchiae formation, and bleeding.4,6,7,10

Using some absorbable materials, the mucosal healing pro-
cess could be more effective and faster.3,4 In some cases, the

absorbable materials could also be associated with slower healing and synchiae formation. This is probably because of

the possibility of osteogenesis initiation.5 One of the newly developed biodegradable nasal packing materials is the

polyurethane foam NasoPore, which is used after FESS operations.5,10 This material could also be impregnated with

steroids or antibiotics to reduce the post-operative discomfort and achieve better clinical outcomes.16,17

The aim of this study was to compare the efficacy of a biodegradable nasal packing (NasoPore) with a tradi-
tional gauze strip packing impregnated with ointment (2 g of
 oxytetracycline and hydrocortisone). The ointment was used to
prevent the adherence of the packing to the mucosa.

The post-operative feeling of pressure was higher in the

control group than on the NasoPore side. On post-operative
days two and 30, this observation was not statistically signif-

icant. On day ten, the feeling of pressure was greater on the

control side, resulting in a significant difference (p < 0.04).

In the authors’ opinion, this was caused by resorption of the

NasoPore, and by stable gauze strip packing and the for-
mation of blood clots around the gauze material. Patient

comfort appears to be improved by the resorbable pack-
ing. The same observations have been reported by other
authors.4,5,10

Parameters including nose blockage, headache, and nasal

pain were generally lower for the NasoPore group than the

control group. On day ten, a statistically significant reduc-
tion of nose blockage (p < 0.02) in the NasoPore group was

observed. This was caused by resorption of the packing

with less debridement in the middle meatus compared to

high secretion and edema mediated by the gauze pack-
ing on the other side. However, although there were no

statistically significant differences for the observed param-
eters during the follow-up, patient comfort appeared to be

much better in the NasoPore group. The same observations

were made by other authors comparing the usage of differ-

ent resorbable and non-resorbable packing materials.3,5,6,10

The study has demonstrated that NasoPore does not sig-

ificantly reduce the risk of post-operative bleeding. The

same results were observed for other resorbable and non-

resorbable nasal packing materials.5–7,9,10

The present study did not find any statistically significant
differences between the packing materials used with regard
to synchiae formation or infection.5,10 Otherwise, if the

patient did not respect the necessity of intense nasal rinsing

in early post-operative period, the formation of synchiae

would be highly likely. The partially dissolvable pack and all
debridement should be suctioned out or washed out if

remaining in place for longer than ten days. The remnants

of the NasoPore could form a bridge between the middle
turbinate and the lateral nasal wall as a point of synchiae

formation.8 On the other hand, some absorbable materi-

als or its remnants could be incorporated into regenerating

mucosa or activate osteogenesis, leading to synchiae for-
mation. This process is responsible for slower mucosal

healing, as described by Shoman.5 The present study found a

significantly better re-epithelialization process in the Naso-
Pore group on day ten (p < 0.001) and nearly complete

| Table 2: Results of synchiae, infection, and re-epithelization between groups. |
|-----------------|---|---|---|-----|---|---|---|
| | Synchiae | Infection | Re-epithelization |
| | N | C | p | N | C | p | N | C | p |
| Day 2 | | | | | | | | | |
| n = 50 | - | - | - | - | - | - | - | - | - |
| Day 10 | 0 | 0 | ns | 0 | 0 | ns | 68.1% | 32.7% | <0.001 |
| n = 49 | | | | | | | | | |
| Day 30 | 3 | 2 | ns | 0 | 1 | ns | 95.7% | 90.2% | <0.06 |
| n = 49 | | | | | | | | | |

N, Nasopore; C, Control; ns, not significant; n, number of patients.
epithelialization 30 days after surgery (95.7%). It is thought that removing the non-absorbable packing could cause local mucosal bleeding and a prolonged phase of blood crusting, which delays epithelialization. Nevertheless, the difference almost disappeared by the late follow-up visit ($p < 0.06$). The same results were observed by Shoman.\textsuperscript{3}

Overall, the NasoPore packing results in better patient comfort and a better healing process after FESS surgery.

**Conclusion**

Using a resorbable NasoPore packing after FESS, the feeling of pressure and nose blockage in the early post-operative period were significantly reduced. The overall patient comfort was higher compared to non-resorbable traditional gauze strip packing. The wound healing was better when using NasoPore, but future investigations are required. Intensive saline douches, three to four times per day, are mandatory after the operation to prevent synechiae formation and fluid resorption by the packing.

**Conflicts of interest**

The authors declare no conflicts of interest.

**Acknowledgments**

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**References**