

Free nasal floor mucosal grafting after endoscopic total ethmoidectomy for severe nasal polyposis: a pilot study*

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Background: We report a novel surgical technique based on an endonasal free mucosal graft (mucoplasty) for improving clinical results and local healing in chronic rhinosinusitis with nasal polyps (CRSwNP).

Methods: Patients diagnosed with bilateral CRSwNP scheduled for endoscopic sinus surgery were included. They underwent complete removal of anterior and posterior ethmoid cells, in addition to bilateral type III frontal sinusotomy. An endoscopic mucoplasty was performed in the left nasal cavity, whereas the right nasal cavity served as control. Patients were evaluated before surgery and 6 months after operation, including Sino-Nasal Outcome Test (SNOT-22), Visual Analogue Scale (VAS) for olfaction, endoscopic evaluation using the Modified Lund-Kennedy (MLK) scoring system and healing evaluation.

Results: Ten patients (mean age 53.6 years) were included. A significant decrease of SNOT-22 score from 57.0 (21.1) to 20.3 (20.6) ($P = 0.024$) and a non-significant decrease of VAS for olfaction score from 9.3 (0.5) to 4.6 (3.9) were found. Preoperative mean MLK score was 4.9 (0.7) in the right nostril and 4.8 (1.0) in the left one. After operation, there was a greater decrease of MLK score in the left nostril than in the right (1.9 [1.0] vs. 1.3 [0.8], $P = 0.034$). Better healing was proved in the nostril with the mucoplasty.

Conclusion: Endonasal mucoplasty could be an effective, safe and feasible complementary surgical procedure in the treatment of CRSwNP. The reduced local edema associated with lower amount of secretions may confer a better control in the frontal recess, orbital wall and nasal roof.

Key words: Nasal polyps, sinusitis, nasal surgical procedures, rhinitis/complications, ethmoid sinus

Introduction

Effective treatment of chronic rhinosinusitis with nasal polyps (CRSwNP) remains a clinical challenge mainly due to the high rate of recurrent polypoid masses⁽¹⁾. Endoscopic sinus surgery has been a major advance for improving symptoms and quality of life in patients with CRSwNP^(1,2). An adequate control of frontal sinus outflow associated with the complete removal of the anterior and posterior ethmoid cells would lead a more homogeneous healing and a greater space for topical corticosteroid treatment⁽³⁾. This surgical approach also allows a better control of the nasal cavity roof and the frontal recess in the postoperative period⁽⁴⁾. This is the region where polypoid recurrences

present a greater difficulty of control⁽⁵⁾.

Recently, skin grafting (dermoplasty)⁽⁶⁾ has been proposed as a complementary procedure to improve local healing in patients with CRSwNP undergoing surgical treatment. This surgical technique has been successfully used in the management of other endonasal conditions, such as recurrent haemorrhage by septal perforation⁽⁷⁾. Mucosal transplants have also been proposed for improving local healing in frontal sinus surgery⁽⁸⁾. Mucosal grafts and flaps are frequently used for treating complications of endonasal surgery (e.g. fistula, endonasal bleeding) because of their great versatility and local efficacy⁽⁹⁾. Taking advantage of early mucosal recovery associated with mucosal grafting^(10,11), a

novel surgical technique based on the use of an endonasal free mucosal graft was developed. Endonasal mucoplasty is used to cover the denuded osseous nasal roof after performing a complete ethmoidectomy, associated with a frontal sinusotomy grade III⁽¹²⁾ for CRSwNP. The objective of this study was to report the first experience with this procedure in a small series of 10 patients with CRSwNP undergoing free mucosal grafting and to compare the results obtained with the contralateral control nostril. Severe nasal polyposis imposes a challenge when it comes to preventing recalcitrant disease. This technique may help future patients.

Material and Methods

Design and participants

Between March and November 2017, patients with bilateral CRSwNP referred to the Rhinology Unit of a tertiary care hospital in Seville, Spain, for evaluation and surgical treatment were eligible to participate in a prospective study. All patients met the diagnostic criteria of CRSwNP established by the European Position Paper on Sinusitis (EPOS)⁽¹³⁾. Inclusion criteria were the following: patients of both sexes, aged 18 years or older, with polyp size for each nostril scoring 2 (moderate-sized polyps not crossing the lower edge of the inferior turbinate) or 3 (large polyps crossing the lower edge of the inferior turbinate) using the Lildholdt's scale⁽¹⁴⁾. Patients with CRS without nasal polyposis or patients with unilateral CRSwNP were excluded from the study, as were patients with systemic diseases, asthma, neoplasms, history of prolonged use/abuse of decongestant nasal spray (i.e. xylometazoline) and pregnant or breastfeeding women. All participants met indication for surgical treatment as outlined by Rudmik et al.⁽¹⁵⁾. The study was approved by the Ethics Committee for Clinical Research of Hospital Virgen de la Macarena, Seville, Spain. All participants were fully informed of the surgical procedure and the purpose of the study and gave written informed consent.

Surgical technique

Patients underwent a complete endoscopic surgical elimination of the anterior and posterior ethmoid cells, in addition to a bilateral grade III frontal sinusotomy. The anterior and posterior ethmoidal arteries were identified bilaterally (by two otorhinolaryngologists with experience in advanced sinonasal endoscopic surgery). Subsequently, the residual septa were cleaned thoroughly with wide exposure of the anterior cranial base, including posterior wall of the frontal sinus and lamina papyracea. A 45° endoscope and angled self-refracting milling machines were used during the dissection. It is important to remove completely all the mucosa of the skull base and lamina papyracea since the graft should be in contact with bone in all its extension. Failure with this mucosal removal can lead to the development of a mucocele due to the presence of mucosa trapped underneath

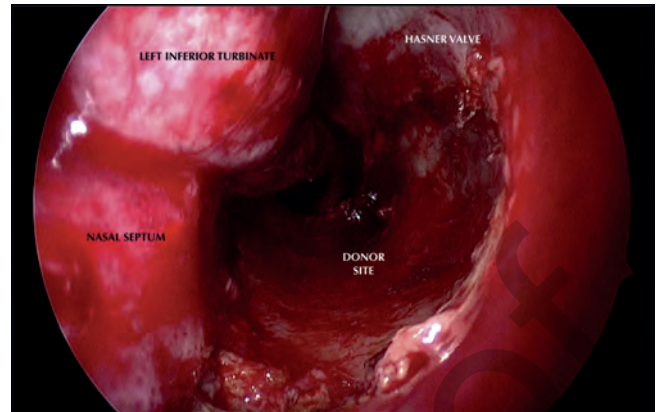


Figure 1. Inferior meatus of the left nostril showing the region for obtaining the mucosal graft. The Hasner valve and the limits of the graft are also shown.

the graft. Afterwards, an endoscopic mucoplasty was performed in the left nasal cavity, consisting of the placement of a free mucosal autograft, in the nasal roof, obtained from the floor of the homolateral nasal cavity, which is a region consistently free of polyps.

The first step consists of graft harvesting, which is obtained from the ipsilateral nasal cavity floor mucosa. The limits of the mucosal graft include the posterior border of the horizontal portion of the palatine bone (posterior limit), the inferior insertion of the nasal septum along the maxillary crest (medial limit) and the inferior meatus mucosa up to the insertion of the inferior turbinate to the lateral wall (lateral limit), respecting the Hasner valve, and the anterior limit reaches the transition between mucosa and skins. The final surface of the graft is about 3 x 4 cm² (Figure 1). Step 2 consists of placement of the graft in the ipsilateral nasal roof covering the anterior ethmoidal artery partially, as the previous limit. The grafted mucosa would run along 2-3 cm posteriorly until reaching and covering the posterior ethmoidal artery. Laterally it should reach the angle formed by the lamina papyracea and the ethmoidal roof, covering almost all of the lateral lamella of the cribriform area (Figure 2). The final step (step 3) consists of fixation of the graft with an adhesive matrix of fibinogen and human thrombin (Tachosil®). This technique was carried out only in the left nostril, whereas the right nostril served as control. Randomization was not performed and the left side was pre-defined to undergo the new endonasal mucoplasty procedure as part of protocol in the study. All patients received postoperatively a standard treatment consisting of frequent nasal saline irrigations and two mometasone furoate applications in each nostril twice a day continuously during the follow-up period.

Assessments

Patients were evaluated before surgery and at 6 months after

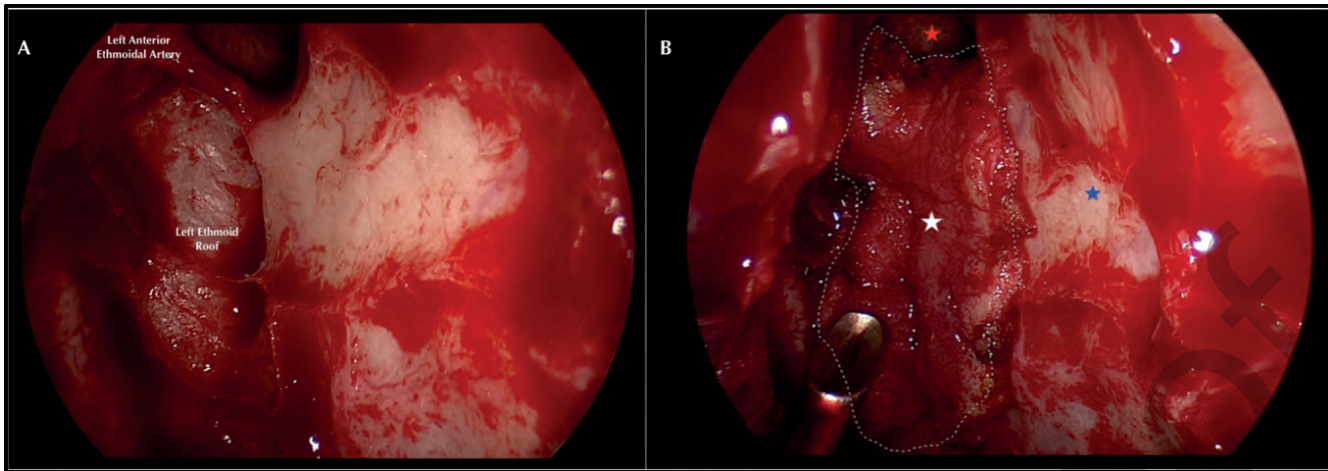


Figure 2. A) Complete ethmoidectomy. The detail of the left anterior ethmoidal artery can be observed. Left ethmoidal roof. B) Free graft placed on the anterior ethmoidal roof. The limits of the graft are identified: graft (white star), orbital lamina of ethmoid bone (blue star), frontal recess (red star).

operation for symptoms and patient reported outcome measures, including Sino-Nasal Outcome test (SNOT-22) and 10-cm visual analogue scale (VAS) for olfactory assessment (from 0: normal sense of smell to 10: anosmia). An endoscopic evaluation using a Modified Lund-Kennedy (MLK) score¹⁶, and a subjective endoscopic evaluation of healing by the investigator were also performed. A preoperative sinus CT scan for evaluating the extension of the disease and planning the surgical procedure was obtained. Sinus CT scan images were evaluated using the Lund-Mackay score. Assessments of SNOT-22, VAS, and Lund-Mackay scores were not individualized by site.

Statistical analysis

Categorical variables are expressed as frequencies and percentages, and continuous variables as mean and standard deviation (SD). Differences between preoperative and postoperative values were compared with the Wilcoxon signed-rank test because distribution of variables departed from normality. Statistical significance was set at $P < 0.05$. Data were analyzed with the SPSS statistical package (22.0.0.0) for MAC iOS.

Results

A total of 10 patients, 2 women, with a mean (SD) age of 53.6 (13.3) years were included in the study. All patients were diagnosed with bilateral CRSwNP, with a mean preoperative Lildholdt score of 2.5 (0.6). Results of other preoperative assessments included a mean (SD) Lund-Mackay score of 17.2 (5.1), SNOT-22 score of 57.0 (21.1), VAS for olfaction score of 9.3 (0.5), and MLK scores of 4.8 (1.0) and 4.9 (0.7) in the left and right nostrils, respectively.

Six months after surgery, improvement of symptoms was found in all patients, with a significant decrease of SNOT-22 score from 57.0 (21.1) to 20.3 (20.6) ($P = 0.024$) and a non-significant

decrease of VAS for olfaction score from 9.3 (0.5) to 4.6 (3.9). Subjective endoscopic evaluation by the investigator showed a better healing, a decrease in the production of secretions and a lower development of mucosal edema in the frontal recess, orbital wall and nasal roof, in the fossa with the mucoplasty, when compared with the contralateral nasal fossa. Postoperative, the mean MLK scores decreased in both nostrils but improvement at 6 months was greater in nostrils with mucoplasty than in controls (mean 1.3 [0.8] vs. 1.9 [1.0], $P = 0.034$) (Figure 3).

Endonasal mucoplasty was feasible in all patients (Figures 4: A-C). The donor site in the ipsilateral nasal floor with the mucoplasty did not show associated morbidity and correct healing occurred in all cases (Figure 4D). No intraoperative complications were recorded. Clinical photographs that illustrate the appearance of both grafted and non-grafted sides after 6 months are shown in Figure 5.

None of the patients presented immediate postoperative complications. No major complications (cerebrospinal fluid leak, hemorrhage, orbital damage) occurred within the 6 months after surgery. In one patient, an asymptomatic residual left frontal sinusitis was identified after a routine revision CT-scan. A partial frontal ostium stenosis was developed in the grafted side. This patient underwent revision surgery of the frontal sinus with complete resection of the middle turbinate and frontal reopening. The process was resolved successfully with an optimal frontal drainage. The postoperative clinical course was uneventful.

Discussion

The main finding of our pilot study is that this novel endonasal mucoplasty was safe and effective to improve clinical outcomes in patients with CRSwNP as evaluated using MLK, with minimal local morbidity at the donor site. Most of the patients showed a

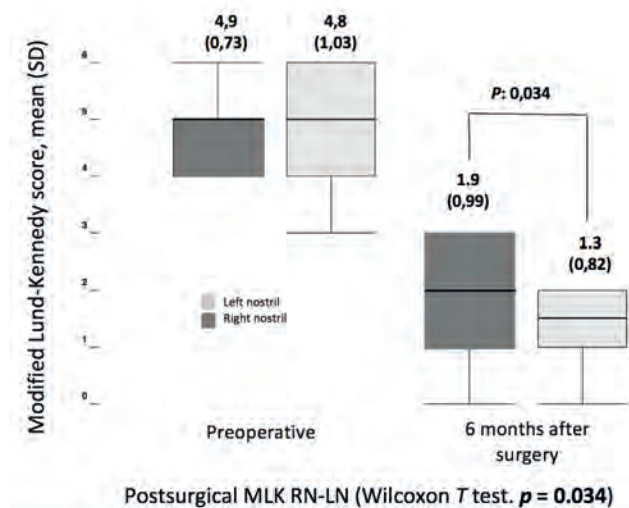


Figure 3. Comparison of mean (SD) scores of modified Lund-Kennedy (MKL) before operation and after 6 months of surgery, with significantly higher decreases in left nostrils (mucoplasty) than in right nostrils (control).

better healing in the fossa with the mucoplasty, when compared with the contralateral nasal fossa. It may be hypothesized that the transfer of a nasal mucosa commonly not associated with nasal polyps, like the nasal cavity floor mucosa, to an area where polyps frequently arise, might be beneficial. A possible “polyp-resistant” mucosal growth would be promoted, starting from a healthy mucosa, in a confluent ethmoidal roof region and frontal recess. This pilot study suggests a superiority of the mucoplasty side compared to the non-mucoplasty side in the same patient in the short time, as evaluated using MLK and a better healing.

Complete anteroposterior ethmoidectomy associated with a bilateral grade III frontal sinusotomy⁽¹⁷⁾, has emerged as an effective option in the surgical treatment of patients with chronic rhinosinusitis with recurrent nasal polyps^(3,5,18). The complete extraction of the ethmoid cells and reduction of septa allows a better treatment of the region⁽⁴⁾. This region constitutes a clinical challenge for the overall control of the CRSwNP. On the other hand, the benefit on the local healing of free mucosal grafts or vascularized flaps has been commonly associated with its use in special situations, such as the resolution of intraoperative or postoperative complications⁽¹¹⁾.

The scarring of the donor region was asymptomatic and did not interfere with the clinical course or the quality of life of patients during the postoperative period. Also, no local complications were reported by the patients. On the other hand, mucosa from nearby structures such as the lower third of the septum or the caudal aspect of the inferior turbinate may be used for grafting, which may be applicable in the repair of larger skull base defects⁽¹⁹⁾. We consider that the use of mucoplasty could be extended

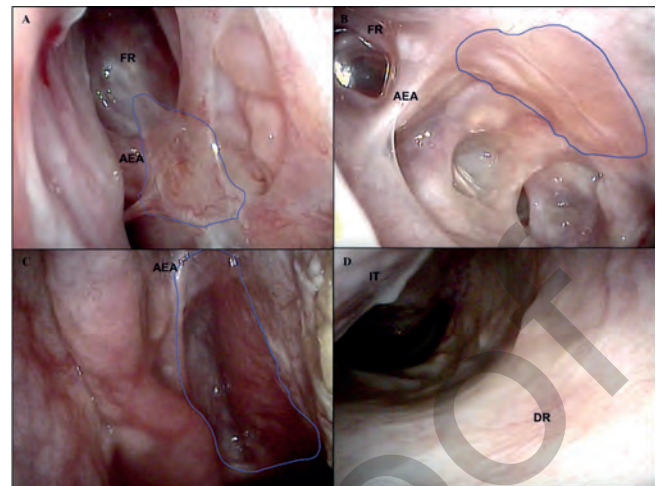


Figure 4. A) Left endonasal mucoplasty. Graft result on the ethmoidal roof of the left nostril. Blue line corresponds with free graft. AEA: the left anterior ethmoidal artery. FR: is the left frontal recess. B) Result of left endonasal mucoplasty. Blue line corresponds with the surface of the graft. AEA: the left anterior ethmoidal artery. FR: is the left frontal recess. C) Another case with a left mucoplasty where the blue line corresponds with free graft. AEA: anterior ethmoidal artery. D) Inferior meatus of the left nostril. DR: Donor region after healing. IT: the inferior turbinate (white star).

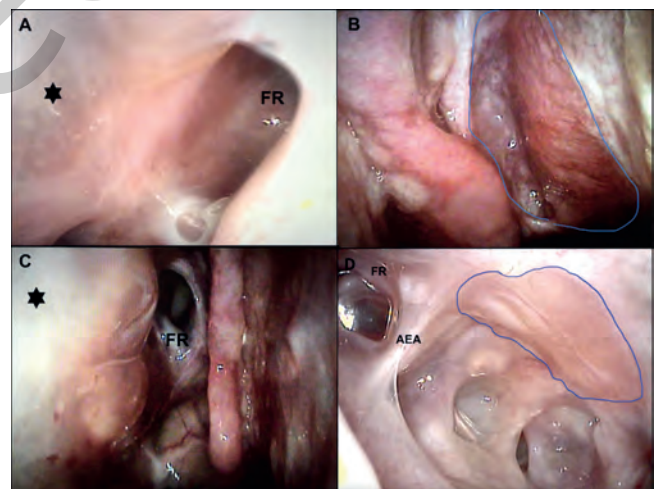


Figure 5. Images A and C (right nostril): The black star shows mucosal edema at the level of the orbital wall in the right nostril of two patients undergoing surgery without mucoplasty. It shows the frontal recess (FR). Images B and D (left nostril): the blue line shows the graft (mucoplasty). FR: frontal recess. AEA: Anterior ethmoidal artery. No edema is seen.

to inflammatory diseases of high severity such as recalcitrant polyposis, cystic fibrosis or Churg-Straus syndrome, which may require a larger area coverage.

The endoscopic sinus surgery improves nearly all subjective and objective measures of olfaction⁽²⁰⁾, which is a clinically

relevant aspect for the patients with CRSwNP. In our study the smell improved postoperatively in all patients. The placement of a nasal floor muosa graft respects the olfactory region not affecting the olfaction, as evaluated using a VAS, indicating that mucoplasty had not a detrimental effect on this variable. A potential limitation should be considered as evaluation of olfaction differentiating between the two nostrils was not performed. On the other hand, the results in the SNOT-22 scale were satisfactory, confirming a relevant decrease of the impact of the disease in the individual health.

Of note, the duration of the surgery can be increased with this type of technique, due to graft depletion and placing, which would take 20-30 minutes, and the increase in surgical complexity derived from the need to clean septa and cells in complete ethmoidectomy. These aspects would constitute a technical difference compared to the functional endoscopic endonasal surgery and require a greater specialization and surgical experience. Other considerations include the potential morbidity of the technique that may result from the more extensive procedure and the requirement of harvesting a graft from the homolateral side. Stripping of the mucosa may be technically not so easy and may increase the possibility of skull base or orbital injury during the performance of the sinus surgery, although studies of nasal centripetal endoscopic sinus surgery have not shown an increase in the risk of complications^(21,22). Complications in the immediate postoperative period did not occur and a single case of asymptomatic frontal ostium partial stenosis was reoperated and stenosis of the frontal ostium was repaired, resulting in a good patency of the frontal ostium. On the other hand, the endoscopic improvement obtained in the study may be considered modest, but decreases in MLK scores after operation versus preoperative values were significantly greater in nostrils with mucoplasty than in controls. Moreover, the minimal clinically important difference for the modified MLK score remains to be defined. The duration of follow-up of 6 months is a limitation of the study, but a 6-month period seems adequate to assess preliminary results, particularly safety and feasibility of the procedure, prior to more definitive studies being performed. Finally, the nasal endoscopy was not performed by a blind specialist and therefore it is possible that the left side would have been evaluated as better than the right site in

favour of the new technique. Further evaluator-masked studies should be performed. Also, a potential bias may be related to the lack of randomization, since the left side chosen for the new technique was pre-defined a bit rarely.

The present findings should be interpreted taking into account that this was a pilot study performed in a small series of patients followed for a limited period of 6 months, but raises the interest in implementing these advanced endoscopic surgery techniques to the surgical management of the more complex patients with recalcitrant CRSwNP which seem to benefit from more radical techniques.

Conclusions

Endonasal mucoplasty may be an effective, safe and feasible complementary technique to different surgical options in the treatment of CRSwNP. Endonasal mucoplasty favours the control of the disease locally. The lower local edema associated with the lower amount of secretions could confer a better control of the region treated by endoscopic mucoplasty. Potential extra cost of the procedure would be mainly associated with the need of reoperation due to a higher incidence of complications, but the fact that reoperations in our series were limited to a single case does not allow drawing conclusions.

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Authorship contribution

Conception: MLR, GGJ, SGS. Design: MFE, MLR, SGS, CBA, CDPN. Supervision: MLR, MFE, SGS, CBA, CDPN. Resource: MFE, MLR, SGS. Materials: MLR, GGJ, SGS, MSJM, LC. Data collection and/or processing: MLR, GGJ, MFE, SGS, MSJM. Analysis and/or interpretation: DDE, MFE, MLR, SGS, CBA, CDP, LC. Literature search: MLR, GGJ, MFE, SGS, MSJM. Writing: MLR, SGS, CBA, CDPN, LC. Critical reviews: MLR, SGS, CBA, CDPN, LC.

Conflict of interest

No conflicts of interest to disclose.

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