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Modified posterior nasal nerve neurectomy with inferior turbinoplasty, as a treatment for intractable rhinitis syndrome: a long-term effect prospective cohort study

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ORIGINAL ARTICLE

Modified Posterior Nasal Nerve Neurectomy with Inferior Turbinoplasty, as a Treatment for Intractable Rhinitis Syndrome: A Long-term Effect Prospective Cohort Study

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Abstract

Background: **Allergic and vasomotor rhinitis are a well-known medical entities affecting a huge population. In most cases, medical therapy helps these people. However, sometimes these treatments are often ineffective. The surgical treatment of intractable rhinitis had been introduced a long time ago, starting from vidian nerve neurectomy to a recently introduced more simple and safe procedure [endoscopic posterior nasal nerve (PNN) neurectomy]. This study combined two valid and widely used surgical procedures for intractable rhinitis surgical management, that is, modified PNN neurectomy and inferior turbinoplasty (IT), aiming to ensure long-term results.**

Patients and methods: **A total of 30 adult patients were enrolled for this prospective study, during the period between January 2018 and May 2021, in the age group between 21 and 50 years of both sexes, diagnosed with chronic intractable rhinitis with failed medical therapy. All patients underwent a simple computed tomogram of the nose and paranasal sinuses before and after surgery as well as a diagnostic nasal endoscopy. Patients were evaluated using the Okuda system and the rhinoconjunctivitis quality-of-life questionnaire. Endoscopic microdebrider IT and selective PNN neurectomy with tragal cartilage interface were applied to all patients.**

Results: **The overall rhinitis symptom score sheet was significantly improved after the procedure, and also, Lund−Kennedy endoscopic score significantly changed from the first month following surgery, and the airway space significantly improved. The QOL of the patients was highly and significantly improved, and it was still stable and valid for the next 18 months after the operation.**

Conclusion: **Our modified posterior nasal neurectomy combined with IT procedure was an effective, long-term lasting, and safe method to treat intractable postnasal discharge syndrome.**

Keywords: Inferior turbinoplasty, Intractable rhinitis, Posterior nasal neurectomy

1. Introduction

Rhinitis may be caused by allergies, or vasomotor rhinitis, among other causes. Most of the time, medical therapy helps these patients feel better. Typically, medical treatment is the most prevalent type of therapy (histamine antagonists, leukotriene receptor antagonists, intranasal or systemic corticosteroids, etc.). However, these drugs frequently fail to work and add significantly to the cost of long-term care. Furthermore. social humiliation brought on by persistent rhinitis symptoms has a significant effect on patients' quality of life.

Most literature considers the rhinitis resistant or intractable when there is a persistence of two or more of four symptoms (itching, sneezing, rhinorrhea, and block) for more than 1−2 years after maximum standard medical therapy.

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Surgery is only required when other forms of treatment are ineffective. In 1961, Golding-Wood [1] published the first description of vidian neurectomy as a remedy for allergic and vasomotor rhinitis. This treatment is currently infrequently performed because of the high prevalence of problems such disrupted lacrimal secretion, dry eye, numbness of the cheek and gums, and high recurrence rate in short time (<1 year).

Terao et al. [2], proposed a method in which the posterior superior nasal nerve and sphenopalatine artery (SPA) were coagulated and treated using cryosurgery at the sphenopalatine foramen. However, there is a chance of intraoperative bleeding from the SPA with these procedures because the artery is not severed under direct observation.

Then, in 1997, Kikawada [3] provided a direct vision endoscopic method for resecting the posterior nasal nerve (PNN) and controlling intraoperative hemorrhage. This technique provides better outcomes than vidian neurectomy while avoiding the problems of vidian neurectomy selecting for only nasal mucosal parasympathetic supply.

Since that time, many surgeons described multiple modifications of Kikawada technique, making use of advancement in endoscopic tools and approaches. All reported results are near to each other, with the main difference in selectivity of PNN section and maneuvers made to decrease rate of recurrence, which is still high for later references to the best of our knowledge [4–6].

PNN neurectomy, a form of highly selective vidian neurectomy that reduces nasal mucosal hypersensitivity and decreases associated secretory activity, is used to successfully treat severe allergic rhinitis [7–9]. Additionally, PNN lessens the possibility of adverse effects from permanent vidian neurectomy, such as persistent dry eyes and palate numbness [10].

Our study aims to evaluate the short-term and long-term results of endoscopic selective modified PNN neurectomy with inferior turbinoplasty (IT) in treating patients with severe intractable allergic rhinitis and persistent nasal blockage. This is done by measuring postoperative improvement results subjectively and objectively and reporting any possible complication like SPA bleeding, nasal adhesion, infection, postoperative pain, eye dryness, mouth dryness, and numbness of the palate or cheek.

2. Patients and methods

2.1. Patient selection

After receiving the necessary consent, 30 adult patients with chronic persistent rhinitis were enrolled in this prospective trial. The included patients who qualified for this study had two or more rhinitis symptoms (including nasal obstruction) that were resistant to the most aggressive medical treatment for at least 1–2 years, and have a reduced quality of life.

A history of previous sinonasal surgeries, diabetes mellitus, hypertension, chronic heart disease, and systemic causes of rhinitis (hormonal, drug-induced), as well as patients with any morphological changes, such as chronic sinusitis, polypoidal nasal mucosa, sinonasal polyposis, deviated nasal septum, crocked noses, and nasal valve issues, were all disqualified from participating in the study.

Patients underwent IT and PNN neurectomy during the period between January 2018 and March 2021 at Dallah Hospital KSA and Ain Shams University Hospitals, Cairo, Egypt. The institutional Research Ethics Board reviewed and approved the study.

Using Okuda's system, a subjective evaluation of the patients was done 2 weeks before surgery as well as 3, 6, 12, and 18 months later. On a scale of 0–4, each symptom (average number of sneezes per day, frequency of rhinorrhea, degree of nasal blockage, and overall severity) is numerically rated according to its severity (0 = none, 1 = mild, 2 = moderate, 3 = severe, and 4 = very severe) [11]. This system is a successful numerical score-based method that takes into account the frequency and intensity of each symptom that has an effect on the patient's condition.

An Indian-validated version of the rhinoconjunctivitis quality of life questionnaire (RQLQ) was used to evaluate the quality of life. The 28 items in this survey are divided into seven groups: activity restriction, sleep issues, eye and noneye/nose symptoms, practical issues, and emotional aspects. By responding to three questions in the activity section, the user can select the three activities that are most restricted owing to rhinitis. Each item is scored on a seven-point scale, ranging from 0 (not at all impaired) to 6 (severely impaired). The mean of all 28 responses is used to obtain the average RQLQ score. Consideration is given to a change in RQLQ score of at least 0.5, which is clinically significant [12,13]. This grading was employed before surgery as well as 3, 6, 12, and 18 months later.

To evaluate the nose and remove any crusts that needed to be removed, an objective nasal endoscopy was conducted preoperatively. Evaluation was supported by the sign-based Lund–Kennedy endoscopic score, a grading system that rates visual pathologic conditions within the nose and paranasal sinuses (Table 1). Using an endoscope, it

Table 1. Sign based (Lund–Kennedy endoscopic score).

Items	Grade 0	Grade 1	Grade 2
Edema	None	Mild	Severe
Discharge	None	Clear/thin	Thick/purulent
Crusts	None	Middle meatus only	Beyond MM
Adhesion	None	Middle meatus only	Beyond MM
Polyps	None	Middle meatus only	Beyond MM

was applied to each side of the nose independently to evaluate nasal patency and postoperative healing [14].

2.2. Endoscopic grading

This score is used to evaluate the nasal airway patency in the presence of turbinate hypertrophy. After measuring each side separately, the average of the two sides was calculated. Without using topical or systemic decongestants (to assess the usual day-time size), using 0° rigid nasal endoscopes (4 mm), the distance between the inferior turbinate's anterior end and the lower end of the nasal septum was measured (Fig. 1).

Grade 0 = nasal airway greater than 6 mm (easy passage of the 4 mm sized endoscope).
Grade 1 = nasal airway 4–6 mm (easy passage of the 4 mm sized endoscope).
Grade 2 = nasal airway 1–3 mm (limited passage of the 4 mm sized endoscope).
Grade 3 = nasal airway less than 1 mm.

It was carried out both before surgery and 3, 6, 12, and 18 months later.

CT PNS grading: preoperatively and 12th and 18th months postoperatively.

This was accomplished utilizing a 1-mm wide CT coronal section. The nasal cavity's air space was measured between the septum and the IT anterior end just before the middle turbinate's emergence, and again between the septum and IT's posterior end at the level of the posterior choana (Fig. 2). Measurements were collected from the IT's most medial dome (narrowest airway).

2.3. Operative procedure (bilaterally)

General anesthesia was preferably used to perform this surgery owing to the likelihood of SPA bleeding. To decrease venous return, assume a supine position with a reverse Trendelenburg stance. Both a high-resolution camera and a 4-mm rigid endoscope with a ‘0’ degree are employed. A 1 : 2 00 000 adrenaline solution was injected into the lateral nasal wall, just beyond the posterior fontanel, on the posterior side of the middle meatus, using a 25-G spinal needle. All the participants had PNN neurectomy and IT as follows.

We used a microdebrider bony drill and submucosal shaver to reduce the volume of the IT. The excess bony part and excess of edematous submucosal tissue were removed leaving the outer mucosa to cover the area of bone removal in physiological way aiming to keep structure (bone and mucosa)

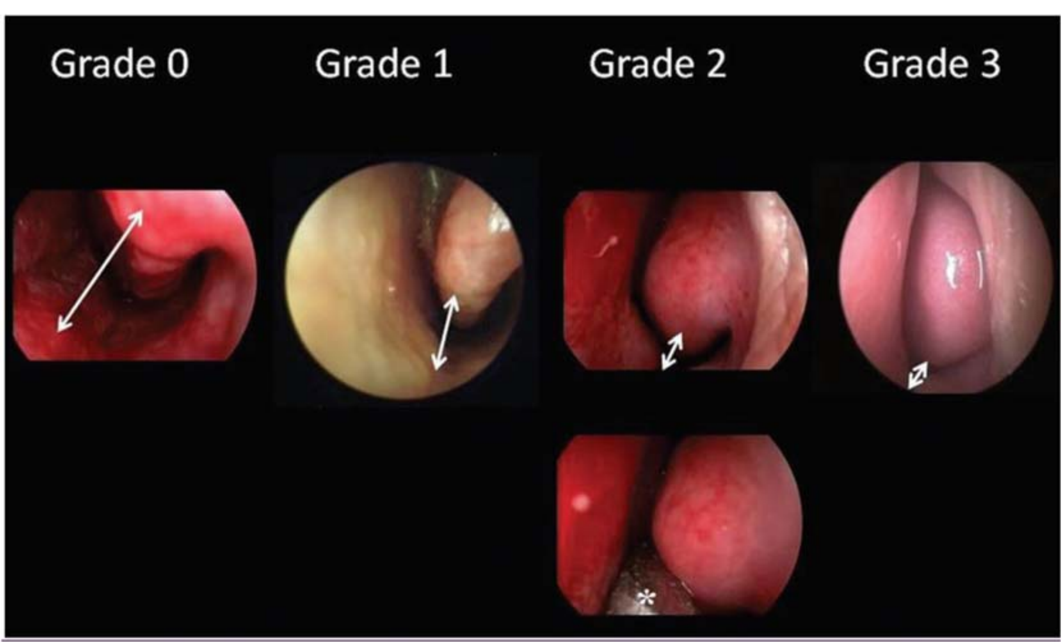

Fig. 1. Endoscopic grading score used to evaluate the nasal airway patency in the presence of turbinate hypertrophy [15].

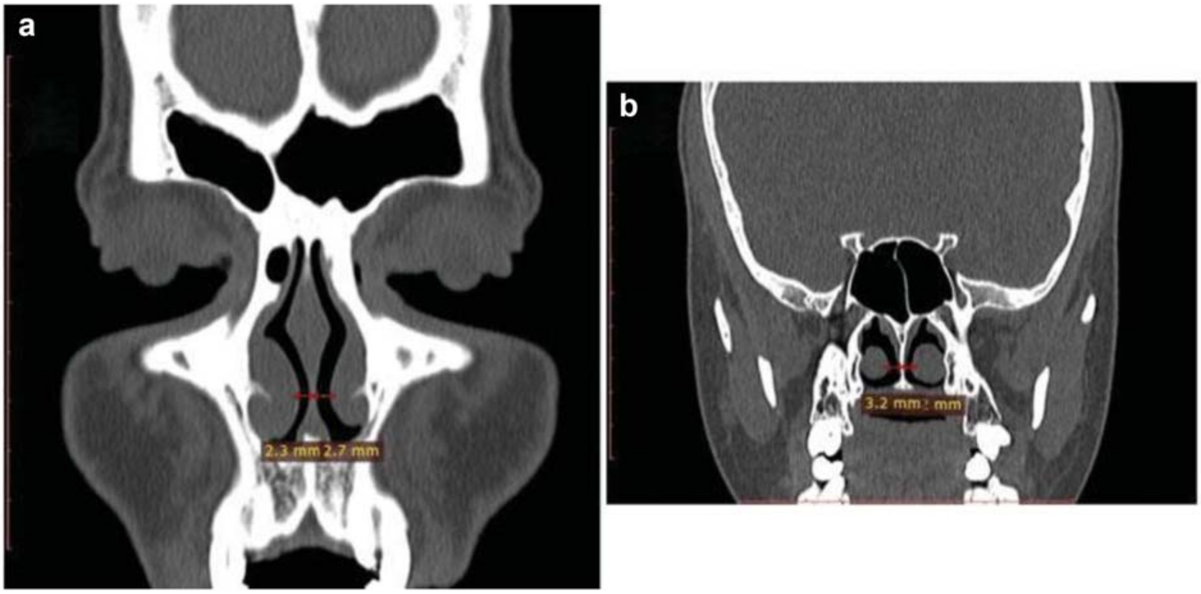

Fig. 2. Computed tomography measurement of inferior turbinate in asymptomatic adult [16]. (a) Measurement was taken between anterior ends of the inferior turbinate (IT) and the septum just before appearance of the middle turbinate. (b) Measurement was taken between the septum and the posterior end of the IT at the level of posterior choana.

near normal size without raw area to decrease crustation and improve healing after surgery.

Then, diathermy was used to create a long vertical incision (Fig. 3a). Palpation was used to locate the posterior end of posterior fontanel. A vertical lateral nasal incision was done at the connection of the IT. Sometimes we used a no.15 blade surgical knife or a flag for microear surgery for this step, but we preferred to utilize needle tip electrocautery or Colorado needle for the same step.

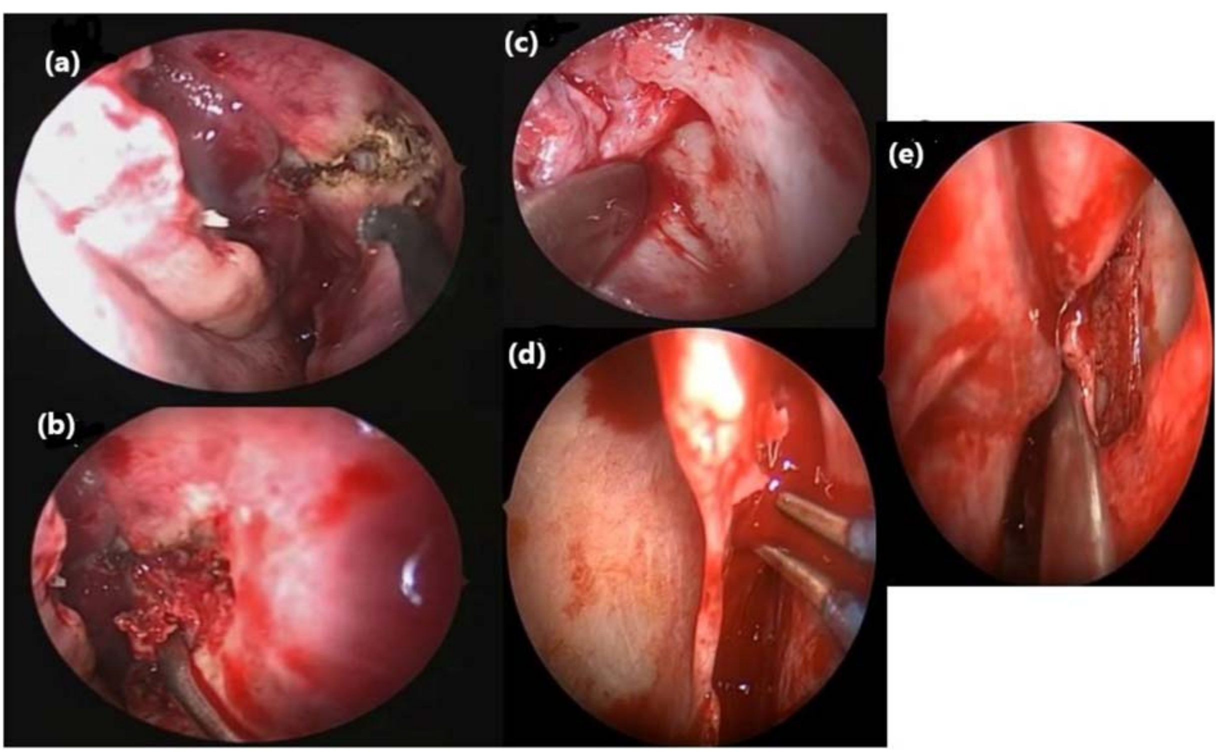

Fig. 3. Steps of PNN neurectomy. (a) Marking the site of incision with diathermy. (b) Dissection. (c) Exposure. (d) Cauterization. (e) Tragal cartilage graft insertion.

We modified the technique by performing first uncinectomy and middle meatal antrostomy to evaluate the sinus mucosal condition, get landmark for the posterior wall of the maxillary sinus, and keep area ready for emergency ligation of SPA in case of injury.

Then tiny incisions were made around the PNN, which is coated with a thin layer of mucoperiosteum that was gently raised into place. The SPA may be damaged if the flap is lifted forcibly. In most cases, a little part of the PNN may be detected within millimeters of the foramen after severing it (Fig. 3b). Sphenopalatine foramen is likely to contain the major trunk or upper part of the PNN (Fig. 3c) as the nerve is divided further after entering the nasal cavity.

To prevent missing a branch, we concentrated more on the nerve's distal end at the sphenopalatine foramen than its proximal end. Bipolar cautery and microscissors were used to cut the nerve after it has been located. We modified the technique by performing only sectioning of the PNN main trunk (the only branch containing parasympathetic fibers) anterior to the SPA just below the ethmoidal crest. Therefore, we could avoid non-necessary numbness of the anterior upper teeth if we cut the posterosuperior lateral nasal nerves, also cutting the main trunk to avoid missing branches with residual symptoms (this is our second modification).

In addition, we modified the technique by adding a very thin layer of tragal cartilage interface between cauterized cut ends of the nerve to ensure that no chance of regeneration and reconnection of nerve fibers to avoid symptoms recurrence again, and this was our third modification.

Following that, surgicel was applied to the mucoperiosteal flaps, and they were reapproximated. The patients underwent minimal nasal packing and were released the next day.

2.4. Follow-up

Following surgery, all patients were checked on at the 1st, 3rd, 6th, 12th, and 18th months. Patient comments were gathered. During the follow-up periods, no antirhinitis drugs were administered.

2.5. Statistical analysis

The acquired data was entered into a master chart and evaluated with the aid of the IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp. The data were displayed as mean SD. Wilcoxon signed-rank test was used to assess postoperative symptom improvement. Statistical significance was defined as a P value less than or equal to 0.05.

3. Results

Our study was conducted on 30 patients. Their age ranged from 21 to 50 years (mean = 32.6 years); 12 of them were males and 18 were females.

Subjective evaluation of the patient was carried out using Okuda's system (Table 2).

With time, there was an improvement in Okuda's system score, with a highly significant difference between preoperatively and 18th month postoperatively, but there was no significant difference between the 12th month and the 18th month postoperatively.

RQLQ was used to evaluate overall quality of life (Table 3). Moreover, the results of the RQLQ improved over time, with a highly significant difference between the preoperative and the 18-month postoperative periods.

With objective assessment by nasal endoscopy, postoperative assessment using the Lund–Kennedy endoscopic score was done on the 3rd, 6th, 12th and 18th month (Table 4). The Lund–Kennedy endoscopic score significantly varied between the 6th and the 18th month following surgery.

Endoscopic grading score was used to evaluate the nasal airway patency in the presence of turbinate hypertrophy (Table 5). With endoscopic grading, there was no significant change between the 12th and 18th month assessments, proving that the disease had not recurred, although there was a significant difference between the preoperative and postoperative 18th month nasal airway patency assessments.

CT PNS grading score was done preoperatively and 12th and 18th month postoperatively using CT coronal section with 1-mm section width (Table 6).

There was a highly significant difference regarding airway space in the right and left sides preoperatively and 12th month postoperatively (Table 6a).

There was no significant difference regarding airway space in the right and left sides 12th month and 18th month postoperatively (Table 6b).

No participant complained of postoperative epistaxis, had a perforated nasal septum, or developed a nasal septal abscess throughout the observation period. In our investigation, there were no patients with treatment-required lacrimal dysfunction or buccal/gingival numbness (Fig. 4).

4. Discussion

When a patient is unresponsive to conventional medical treatment regimens for their allergic

Table 2. Subjective evaluation was performed with Okuda's system.

Time period	Sneezing	Rhinorrhea	Nasal obstruction
Preoperative	3.185 ± 1.14	2.850 ± 1.32	2.982 ± 1.51
3rd month postoperative	0.911 ± 1.11	0.092 ± 0.29	1.001 ± 102
6th month postoperative	0.872 ± 1.01	0.081 ± 1.12	0.801 ± 1.08
12th month postoperative	0.813 ± 0.23	0.070 ± 1.34	0.610 ± 1.30
18th months postoperative	0.901 ± 1.02	0.069 ± 1.23	0.309 ± 1.28
Preoperative vs. 18th months postoperative (*P* value)	0.0001[a]	0.0001[a]	0.0001[a]
12th months postoperatively vs. 18th months postoperatively (*P* value)	0.647[a]	0.998[a]	0.37[a]

P value more than 0.05: nonsignificant difference.
P value less than 0.05: significant difference.
P value less than 0.001: highly significant difference.
[a] *t* test.

Table 3. Rhinoconjunctivitis quality-of-life questionnaire.

Parameters	Preoperative	3rd month postoperative	6th month postoperative	12th month postoperative	18th month postoperative	Preoperative vs 18th month postoperative (*P* value)
Activities	4.01 ± 1.02	3.60 ± 1.12	3.21 ± 0.02	3.01 ± 1.03	1.92 ± 0.02	++ 0.0001[a]
Sleep	3.1 ± 0.02	2.56 ± 0.42	2.23 ± 1.04	2.18 ± 0.21	1.80 ± 0.01	0.0001[a]
Nose symptoms	2.97 ± 0.24	2.90 ± 1.33	2.41 ± 1.04	2.30 ± 1.03	1.16 ± 0.04	0.0001[a]
Eye symptoms	2.93 ± 0.22	2.71 ± 1.06	2.03 ± 0.03	1.90 ± 0.01	1.13 ± 0.01	++ 0.0001[a]
Non nose-eye symptoms	2.82 ± 0.21	2.13 ± 0.02	1.9 ± 0.05	1.40 ± 0.03	1.62 ± 0.01	0.0001[a]
Practical problems	4.10 ± 1.04	3.44 ± 1.05	2.90 ± 0.06	2.13 ± 1.06	1.89 ± 0.03	++ 0.0001[a]
Emotional symptoms	3.82 ± 1.11	3.60 ± 1,03	3.53 ± 1.07	3.37 ± 1.56	2.01 ± 1.01	0.0001[a]

P value more than 0.05: nonsignificant difference.
P value less than 0.05: significant difference.
P value less than 0.001: highly significant difference.
[a] *t* test.

Table 4. Lund–Kennedy endoscopic score.

Items	6th month postoperatively	18th month postoperatively	Difference
Edema	1.91 ± 0.26	1.367 ± 0.21	<0.001[a]
Discharge	1.78 ± 1.20	1.052 ± 0.16	0.0017[a]
Crusts	1.98 ± 1.02	1.32 ± 0.20	0.001[a]
Adhesion	1.85 ± 0.52	1.26 ± 0.39	0.0045[a]
Polyps	0	0	–
Overall score	2.82 ± 1.06	2.19 ± 1.32	0.046[a]

P value more than 0.05: nonsignificant difference.
P value less than 0.05: significant difference.
P value less than 0.001: highly significant difference.
[a] *t* test.

rhinitis, surgery has been recommended as a viable alternative option. One surgical treatment that is now available and widely used is PNN neurectomy.

To the best of our knowledge, the effectiveness of long-term symptom management has not been the subject of many extensive investigations. According to a recent study on long-term symptoms following PNN with ST, objective runny nose and sneezing symptoms started to get worse at 3 years after surgery as opposed to 1 year after surgery [17].

Runny nose and sneezing symptoms may worsen following surgery. According to a recent study using

Table 5. Endoscopic grading score.

	Preoperative	6th month postoperative	12th month postoperative	18th month postoperative	Difference between preoperative and 18th month postoperative	Difference between preoperative 12th and 18th month postoperative
(0) Nasal airway >6 mm	0	58.20%	57%	57.30%	0.0001[a]	1[a]
(1) Nasal airway 4–6 mm	10%	31.80%	32%	31%	0.0002[a]	0.88[a]
(2) Nasal airway 1–3 mm	20%	10%	11%	10%	0.047[a]	0.82[a]
(3) Nasal airway < 1 mm	80%	0	0	0	0.0001[a]	1[a]

P value more than 0.05: nonsignificant difference.
P value less than 0.05: significant difference.
P value less than 0.001: highly significant difference.
[a] *t* test.

Table 6. CT PNS grading (preoperative and 12th month postoperatively airway space).

Measurements	Right				Left			
	Anterior end	*P*	Posterior end	*P*	Anterior end		Posterior end	*P*
Mean airway space preoperatively	1.8 ± 0.6	<0.001[a]	2.9 ± 1.3	<0.001[a]	1.9 ± 0.9	<0.001	3.18 ± 1.7	<0.001[a]
Mean airway space 12 months postoperatively	4.13 ± 1.1		5.50 ± 0.2		4.01 ± 0.9		5.20 ± 0.1	
CT PNS grading (12th month and 18th month postoperatively airway space)								
Mean airway space 6th months postoperatively	4.13 ± 1.1	>0.05	5.50 ± 0.2	>0.05	4.01 ± 0.9	>0.05	5.20 ± 0.1	>0.05
Mean airway 18 months postoperatively	4.1I±1.6		5.48 ± 0.4		4.00 ± 0.7		5.20 ± 0.2	

a rat model, nerve fibers were reinnervated into the mucosa within a few months after PNN [5]. Owing to its near proximity to the sphenopalatine foramen, the PNN and SPA bundle is severed, but nerve regeneration to the pterygopalatine ganglion may still occur gradually after surgery.

We reported a significant decrease in the severity of symptoms and signs postoperatively. Overall, Lund–Kennedy endoscopic score showed a significant decrease after 1 month from the operation.

In accordance to our results, Chen et al. [18] reported that postoperative Lund–Kennedy score was significantly improved after endoscopic PNN neurectomy in treating eosinophilic chronic rhinosinusitis.

Kawamura et al. [19], who operated on 20 patients with chronic allergic rhinitis using a harmonic scalpel, found the same results of our study. These patients reported subjective improvements in their sneezing, nasal discharge, and nasal blockage in proportions of 90, 75, and 100%, respectively.

Additionally, Ogi et al. [17] observed that with time, symptoms such nasal congestion, rhinorrhea, and sneezing decreased. They also stated that although PNN neurectomy is associated with clinical improvements and a low rate of complications, some patients did not fully recover after the treatment.

In accordance to our findings, Kobayashi et al. [20] have noted that submucous turbinoplasty and selective resection of peripheral branches of the PNN can reduce allergy symptoms similarly to complete resection of the PNN. They did point out, however, that patients who underwent complete excision of the PNN showed better improvements in their nasal symptom levels, even if the difference was not statistically significant.

In contrast to our findings, Sonoda et al. [21] found no discernible difference in the sneeze score 3 months after surgery compared with before surgery. This is most likely the case because the preoperative sneeze

Fig. 4. CT preoperatively and 18 months postoperatively. (a, b) Preoperatively at the level of MT, (c, d) preoperatively at the level of the posterior choana, (e, f) postoperatively at the level of MT, and (g, h) postoperatively at the level of the posterior choana. MT, middle turbinate.

score was lower than the ratings for runny nose or nasal congestion. Patient variability and the small patient population may have affected the result.

In our study, ocular problems considerably decreased six months following the operation. According to Sonoda et al. [21], subjective ocular symptom scores at 3 months following surgery were significantly better than they were before surgery, and symptoms got better with time.

Our findings also showed a significant improvement in the mean airway space before and after the procedure. According to a prior study by Fradis et al. [22], a significant improvement was also observed 6 months after the operation. The Gertner-Podoshin plate showed that 73 (80.2%) patients had good nasal breathing two months following surgery, and 64 (70.3%) of 91 patients claimed to have noticed a subjective improvement in nasal breathing.

In a previous study of 51 patients, Fradis et al. [23] found that excellent outcomes were seen in 78% of cases at 2 weeks following surgery and in 76% of cases at 2 months following surgery.

It is true that this study has some limitations. A controlled trial is required to determine whether PNN neurectomy plus IT is more effective than IT alone or PNN neurectomy alone, although it is challenging to do so because IT alone disrupts parts of the branches of the lateral posterior inferior nasal nerve, and a longer period of follow-up is needed.

5. Conclusion

An efficient and secure treatment for unresponsive postnasal discharge syndrome includes IT in conjunction with PNN neurectomy.

Conflicts of interest

There are no conflicts of interest.

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