





## ORIGINAL RESEARCH

# Modified technique improves efficacy for in-office posterior nasal nerve ablation

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## Abstract

**Objectives:** Posterior nasal nerve (PNN) ablation is a minimally invasive treatment option for patients with chronic rhinitis. Recent evidence shows that parasympathetic innervation of the nasal cavity is more extensive and there are many fibers posterior to the lateral attachment of the middle turbinate. We describe a modified ablative technique that targets the extensive innervation of the posterior nasal nerves.

**Methods:** Description of the technique and retrospective cohort analysis. In addition to the traditional radiofrequency and cryoablation targets, three additional treatment sites posterior to the middle turbinate were targeted using radiofrequency ablation, as well as one focused treatment posteroinferior to the middle turbinate attachment using cryotherapy ablation. The primary outcome collected was a 30% improvement in overall rhinitis symptoms.

**Results:** Forty-five patients received treatment and completed 3-month follow-up using the modified technique for radiofrequency and cryotherapy PNN ablation. Previously, our institution documented a 64.5% responder rate at 3 months. After introducing the modified technique, the response rate at 3 months significantly improved (64.5% vs. 91.1%,  $p = .004$ ).

**Conclusions:** This report suggests improved efficacy with implementation of the modified technique for in-office PNN ablation. Given the extensive nature of the post-ganglionic parasympathetic fibers of the nasal cavity which often emerge posterior to the middle turbinate attachment, a modified technique to target these

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branches should be considered. Prospective randomized studies comparing this modified technique to the traditional technique are needed.

**Level of Evidence:** III.

**KEYWORDS**

chronic rhinitis, cryotherapy, middle turbinate anatomy, posterior nasal nerve ablation, radiofrequency therapy

## 1 | INTRODUCTION

Chronic rhinitis (CR) is a common disease affecting up to 30% of the US adult population.<sup>1</sup> The treatment of CR begins with medical therapy including intranasal steroids, anticholinergics, decongestants, or antihistamines.<sup>2</sup> However, in studies of allergic rhinitis, medical therapies have been found to fail to control nasal and ocular symptoms in approximately 20% of patients.<sup>3</sup> Traditionally, following failure of appropriate medical therapy, surgical options targeting three primary areas can be attempted; including the inferior turbinate, posterior nasal nerve (PNN), or vidian nerve (VN).<sup>4</sup> The etiology of non-allergic rhinitis is partly thought to arise from a dysfunction of sympathetic and parasympathetic innervation, leading to increased mucous production and vascular permeability.<sup>5,6</sup> Vidian and posterior nasal neurectomy aim to target these aberrant parasympathetic pathways. While reasonably successful in controlling CR symptoms, vidian neurectomy can have significant complications, most notably eye dryness.<sup>7,8</sup> Thus, vidian neurectomy has fallen out of favor and been superseded by PNN neurectomy with fewer adverse effects, but patients may nevertheless have unsatisfactory symptom resolution.<sup>4</sup>

In recent years, office-based posterior nasal nerve (PNN) ablation has emerged as a popular option for patients who fail to respond to medical therapy.<sup>9,10</sup> Two equally effective and frequently used methods are cryotherapy and temperature-controlled radiofrequency (TCRF) neurolysis.<sup>10</sup> These procedures offer a relatively convenient option compared to traditional surgical treatments. Despite their widespread use, randomized controlled trials report that up to 33% of patients have limited response to treatment.<sup>9,10</sup> The standard approach to these procedures assumes the PNN is primarily located within the posterior middle meatus where treatments are targeted. However, recent evidence shows that parasympathetic innervation of the nasal cavity is more extensive and there are many fibers posterior to the lateral attachment of middle turbinate (MT).<sup>11-13</sup> In light of these findings, this is an exploratory study to assess the effectiveness of a modified technique for PNN ablation, which targets treatment sites both posterior and anterior to the posterior lateral attachment of the MT.

## 2 | METHODS

A retrospective cohort study was performed at a single institution and approved by the Houston Methodist Hospital Institutional Review

Board. Patients with chronic rhinitis (both allergic and non-allergic subtypes as reported by patients) 18 years and older who underwent cryotherapy ablation or TCRF neurolysis of the PNN from July 2021 to February 2022 were reviewed. Patients included had to have failed, or not tolerate, some form of medical therapy for chronic rhinitis. Patients with a diagnosis chronic rhinosinusitis were excluded. Chart review of the electronic medical record was conducted for demographic information, procedure type, as well as post-procedural follow-up/response.

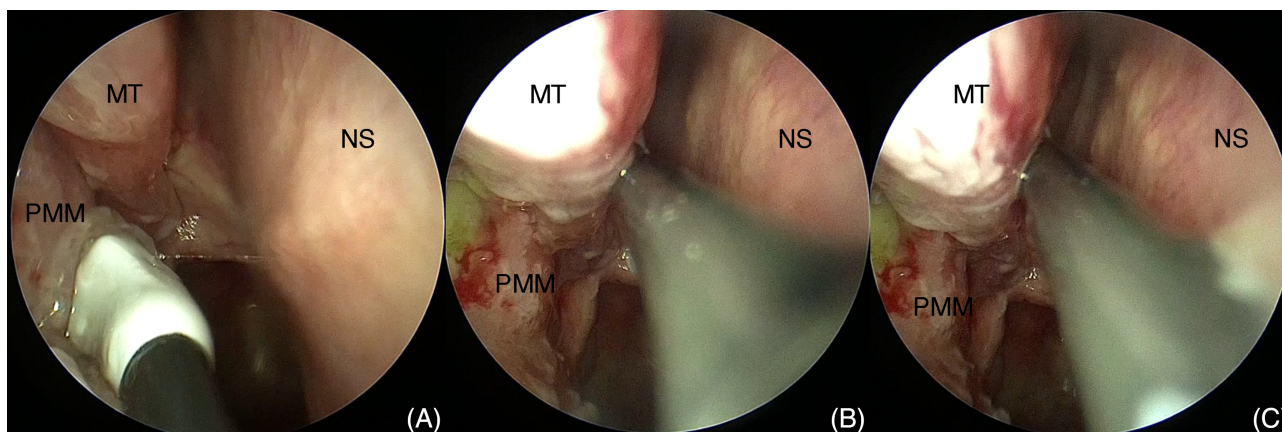
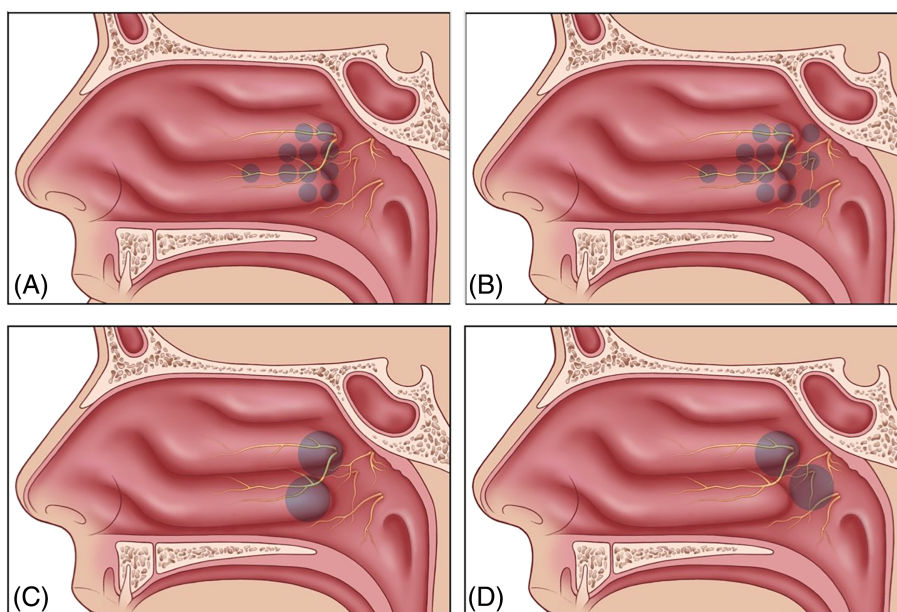
Regarding the techniques performed, cryoablation was done using the Clarifix device (Stryker, Kalamazoo, MI) and the RhinAer device (Aerin Medical, Inc., Mountain View, CA) was used for TCRF. Two board certified rhinologists (M.T. and O.G.) conducted all procedures in office, with preceding application of aerosolized lidocaine/oxymetazoline spray. The traditional technique included four to five non-overlapping treatments in the posterior middle meatus and three to four treatments along the inferior turbinate using temperature-controlled radiofrequency neurolysis (Figure 1A) and two treatments to the posterior middle meatus anterior to the lateral MT attachment with cryotherapy (Figure 1C). We modified the technique to target 3 additional treatments posterior to the MT with TCRF neurolysis and focus one treatment just below and posterior to the attachment of the MT with cryotherapy ablation (Figure 1B,D). Intraoperative images are demonstrated in Figure 2.

The primary endpoint was subjective patient-reported overall improvement of their nasal symptoms at 3 months, as collected at follow-up visit. Patients who did not have office follow up were telephoned to obtain relevant response data. Patients were categorized as responders in a dichotomous fashion (yes/no), if at least 30% improvement in overall rhinitis symptoms (anterior rhinorrhea, postnasal drip, congestion, sneezing) was reported. Pearson chi-square test was used to find the association between categorical variables. The Mann-Whitney *U* test was used to compare continuous and ordinal variables. All statistical analyses were conducted using SPSS version 24 (IBM corporation, Armonk, NY).

## 3 | RESULTS

In total 76 patients were identified who underwent PNN ablation. Thirty-one patients were treated with the standard technique, and forty-five patients received modified technique treatment and completed 3-month follow-up.

**FIGURE 1** Depiction of treatment sites for office-based posterior nasal nerve ablation. (A) Standard temperature-controlled radiofrequency (TCRF) treatment sites. (B) Modified target sites (circles) using TCRF involving regions in the posterior middle meatus, posterior to the middle turbinate, and along the inferior turbinate. (C) Standard cryotherapy treatment sites. (D) Target sites (circles) using cryotherapy neurolysis at the posterior middle meatus and inferior-posterior to the middle turbinate attachment.



**FIGURE 2** Intraoperative nasal endoscopic view of modified technique, demonstrating application of treatment posterior to the lateral attachment of the middle turbinate along the lateral nasal side wall. (A) Treatment of posterior middle meatus. (B) Treatment posterior to middle turbinate on lateral wall. (C) Treatment posterior to the lateral attachment of the MT on the lateral nasal wall. MT, middle turbinate; NS, nasal septum; PMM, posterior middle meatus.

Of the patients who received the modified treatment, 6 (13.3%) patients underwent cryotherapy, and 39 (86.7%) patients underwent temperature-controlled radiofrequency neurolysis ablation. Previously, our institution documented a 64.5% responder rate (defined as at least a 30% improvement in rhinitis symptoms) at 3 months.<sup>4</sup> After introducing the modified technique, the response rate at 3 months significantly improved (64.5% vs. 91.1%,  $p = .004$ ). Patients treated with the traditional technique compared to the modified technique were significantly older on average (67.1 [SD  $\pm$  12.9] vs. 57.1 [SD  $\pm$  16.6],  $p = .006$ ). A sub-analysis of patients older than 50 years likewise found that the response rate significantly improved with the modified technique (64.3% vs. 88.5%,  $p = .038$ ). Four adverse events were noted. Two bleeding events occurred prior to introduction of the modified technique, and two bleeding events occurred after the

introduction of the modified technique. The cohorts differed in procedure type, with patients treated with the standard approach more often undergoing cryotherapy (80.6%) and patients treated with the modified technique undergoing radiofrequency (86.6%) ( $p < .001$ ) (Table 1). However, differences in proportion of cryotherapy or radiofrequency procedures performed were not significantly affected by which surgeon performed the procedure ( $p = .214$ ).

Amongst the modified technique, no significant difference was noted between surgeons' success rates ( $n = 21$  successful/22 performed, 95.46% and  $n = 20$  successful/23 performed, 86.86%) ( $p = .608$ ). In addition, for patients receiving the standard technique, no significant differences were noted in surgeons' success rates ( $n = 12$  successful/21 performed, 57.1% and  $n = 8$  successful/10 performed, 80.0%) ( $p = .262$ ).

**TABLE 1** Baseline characteristics and technique success rates.

Variable	Total (n = 76)	Standard technique (n = 31)	Modified technique (n = 45)	p-value
Age (years)				
Average ± SD	61.2 ± 15.9	67.1 ± 12.9	57.1 ± 16.6	p = .006
Age within subgroups				
≤ 50 years old <sup>a</sup>	40.5 ± 7.1	41.0 ± 5.7	36.7 ± 14.6	p = .773
>50 years old <sup>b</sup>	69.63 ± 9.2	68.9 ± 11.0	70.4 ± 7.9	p = .561
Race/Ethnicity				
Caucasian	56 (73.7%)	24 (77.4%)	32 (71.1%)	p = .125
African American	10 (13.2%)	3 (9.7%)	7 (15.6%)	
Hispanic/Latino	3 (3.9%)	3 (9.7%)	0 (0.0%)	
Asian	5 (6.6%)	1 (3.2%)	4 (8.9%)	
Declined to answer	2 (2.6%)	0 (0.0%)	2 (4.4%)	
Gender				p = 0.357
Male	32 (42.1%)	15 (48.4%)	17 (37.8%)	
Female	44 (57.9%)	16 (51.6%)	28 (62.2%)	
Procedure type				p < 0.001
Cryotherapy ablation	31 (40.8%)	25 (80.6%)	6 (13.3%)	
Radiofrequency neurolysis	45 (59.2%)	6 (19.4%)	39 (86.7%)	
Procedure outcome				p = 0.004
Success	61 (80.3%)	20 (64.5%)	41 (91.1%)	
Failure	15 (19.7%)	11 (35.5%)	4 (8.9%)	

<sup>a</sup>Mean and standard deviation calculated for subgroup of total population, where n = 22.

<sup>b</sup>Mean and standard deviation calculated for subgroup of total population, where n = 54.

## 4 | DISCUSSION

PNN ablation offers a reasonable in-office treatment option for CR patients. Consistent with the published literature, our institution previously identified a 64.5% response rate to PNN ablation.<sup>9–11</sup> The present study demonstrates that the introduction of a modified technique may improve response rate, with a reported 91.1% subjective response at 3-month follow-up.

The concept of ablating the parasympathetic fibers posterior to the MT is supported by recent literature.<sup>11,13</sup> Ogi et al. recently described the extensive nature of the post-pterygopalatine ganglionic parasympathetic fibers of the nasal cavity.<sup>13</sup> Many of these nerve fibers exit foramina posterior to the MT and do not course in the typical location of the posterior middle meatus. Failure of PNN ablation can be partially explained by missing these potential targets.<sup>13</sup> Fan et al. also described the anatomic variability of the MT in relation to the sphenopalatine foramen where large branches of the PNN enter the nasal cavity.<sup>11</sup> Failure of PNN ablation was significantly higher with unfavorable MT anatomy. Targeting areas posterior to the MT along the lateral nasal wall, by partially medializing the posterior portion of the MT, can potentially improve outcomes in patients with unfavorable anatomy.

Other groups have attempted improve outcomes of PNN ablation by addressing multiple locations along the lateral nasal wall. Yen et al. reported on a modified cryoablation technique, where in

addition to the standard middle meatus site, a treatment site at the inferior meatus was added.<sup>14</sup> In their study, cryoablation of the inferior meatus was effective but did not augment treatment response.<sup>14</sup> In contrast, we found that our modified technique using both TCRF and cryoablation was able to augment and significantly improve treatment response. Recent devices also aim to better target the innervation of the nasal cavity. Neuromark (Neurent Medical Ltd., Galway, Ireland) is a radiofrequency ablation device which engages the lateral nasal wall with multiple points of contact in an attempt to increase access points to nerve rich areas including posterior to the lateral MT attachment.<sup>15</sup> In a single arm study of chronic rhinitis patients, the device was found to have a positive response in 78% of patients. While encouraging, this was the first single arm study looking at outcomes for Neuromark, and there is a paucity of long-term safety or efficacy data. Single contact point radiofrequency and cryoablative devices, as employed in our analysis, have been established as safe and efficacious, and we highlight here how a simple modification of the existing technique has potential to improve outcomes.<sup>16,17</sup>

In our experience, TCRF and cryoablation generally have favorable safety profiles, and the introduction of the modified technique has not resulted in increased adverse events. In a study of a national adverse events reporting database, for the Clarifix cryoablation device, epistaxis was found to be the most common reported adverse event (9/12, 75%).<sup>18</sup>

There were several limitations. This is an exploratory study examining a modified technique with a small sample size and short-term outcomes. Treatment durability was not assessed. The heterogeneity of cryotherapy and temperature-controlled radiofrequency neurolysis use pre- and post-technique modification may serve as a confounder. This heterogeneity is accounted for by changing practice patterns over time. Despite this, we believe the modified technique is useful with both treatment modalities. Lastly, subjective responses defined treatment success, rather than pre-and post-procedural reflective total nasal symptom scores.

## 5 | CONCLUSION

This report suggests improved efficacy with implementation of the modified technique for in-office PNN ablation. Given the extensive nature of the post-ganglionic parasympathetic fibers of the nasal cavity which often emerge posterior to the MT attachment, a modified technique to target these branches should be considered. Prospective randomized studies comparing this modified technique to the traditional technique are needed to better assess the viability of this technique.

### CONFLICT OF INTEREST STATEMENT

Masayoshi Takashima: consultant for Aerin<sup>®</sup> Medical, Medtronic, Acclarent<sup>®</sup>, and LivaNova. Omar G. Ahmed: consultant for Aerin<sup>®</sup> Medical and Medtronic.

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