Clinical Outcome of CO2 Laser Inferior Turbinate Reduction in Patients with Nasal Obstruction Due to Inferior Turbinate Hypertrophy in a Tertiary Care Centre, Thiruvananthapuram, Kerala

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ABSTRACT

BACKGROUND

Nasal obstruction secondary to inferior turbinate hypertrophy significantly affects the quality of life. Patients refractory to medical treatment are taken up for surgery. Laser turbinate reduction is an effective and simple method for treatment of nasal obstruction due to inferior turbinate hypertrophy. Only a few studies reported on the outcome of laser inferior turbinate reduction in India. The present study was done to assess the clinical outcome of laser inferior turbinate reduction in patients with nasal obstruction due to inferior turbinate hypertrophy.

METHODS

This prospective observational study was done in 31 patients (18 – 60 years) with nasal obstruction due to inferior turbinate hypertrophy refractory to medical management who underwent laser inferior turbinate reduction in ENT Department, Government Medical College, Thiruvananthapuram from December 2017 to September 2019.

RESULTS

All patients had bilateral inferior turbinate hypertrophy. 21 out of 31 patients had allergic rhinitis and rest had non-allergic rhinitis. Pre-operatively most patients had symptom score between 15 and 20. After CO2 laser inferior turbinate reduction at the end of 3 months of follow up, subjective assessment by symptom scoring confirmed by objective assessment by flowmetry 29 out of 31 patients had good outcome with relief from nasal obstruction. The success rate was more in non-allergic rhinitis (100 %) than the allergic rhinitis group (90.47 %).

CONCLUSIONS

CO2 laser inferior turbinate reduction is an effective procedure to relieve nasal obstruction in patients with inferior turbinate hypertrophy refractory to medical treatment, with minimal complications. Post-procedure on follow up significant number of patients had relief from hyposmia, sneezing and running nose.

KEYWORDS

Nasal Obstruction, Peak Nasal Inspiratory Flowmetry, Symptom Scoring, CO2 Laser, Outcome

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BACKGROUND

Nasal obstruction secondary to inferior turbinate hypertrophy is a source of considerable discomfort and affects the quality of life. Inferior turbinate hypertrophy is usually seen in allergic rhinitis, vasomotor rhinitis, and chronic hypertrophic rhinitis. So along with nasal obstruction patient may be also having sneezing, rhinorrhoea, itching of nose and olfactory abnormalities. Chronic inflammation of nasal mucosa leads to submucosal collagen deposition and remodelling leading to inferior turbinate hypertrophy. Initially symptoms may be responsive to medical treatment with antihistamines, steroid nasal sprays and decongestant nasal drops.[1] Conservative treatments fail in considerable number of cases and are taken up for surgery. There is wide variety of techniques available for surgical reduction of inferior turbinate like total/partial turbinectomy, turbinoplasty, chemical cautery, cryotherapy, diathermy, and laser turbinate reduction.

Laser turbinate reduction is an effective and simple method for treatment of nasal obstruction due to inferior turbinate hypertrophy. Advantages are lack of bleeding, less pain, high precision, good healing of wound and can be done under local anaesthesia even as an out-patient procedure. Different lasers like CO_2 laser, ND-YAG, Diode and KTP lasers have been used. Studies show that laser inferior turbinate reduction significantly reduces the nasal obstruction in inferior turbinate hypertrophy. Clinical outcome of surgery can be assessed by pre-operative and post-operative comparison of symptoms via subjective (by questionnaire) and objective (by Inspiratory peak flowmetry) methods.[1,2,3] Methods for objective assessment of nasal patency include- anterior rhinomanometry, acoustic rhinomanometry, inspiratory peak flowmetry (In check, Wright, Youlten flow meters available). Rhinomanometry is expensive, complex to use and time consuming. Studies done on peak nasal inspiratory flow (PNIF)[4,5] show that it is as good an indication of nasal patency as formal rhinomanometry.

Objectives

Primary objective was to assess the clinical outcome of CO2 laser inferior turbinate reduction in patients with nasal obstruction due to inferior turbinate hypertrophy. Secondary objective was to compare the success rate of laser inferior turbinate reduction in patients with allergic and non-allergic rhinitis.

METHODS

This was a prospective observational study done in patients with nasal obstruction due to inferior turbinate hypertrophy who underwent laser inferior turbinate reduction in ENT Department, Government Medical College, Thiruvananthapuram, from December 2017 to September 2019. All Patients in the age group (18 – 60 years) with nasal obstruction due to inferior turbinate hypertrophy refractory to medical management were included in the study. Patients with nasal obstruction due to causes other than inferior turbinate hypertrophy, nasal obstruction due to hypertrophied turbinate bone, previous h/o nasal surgeries or nasal trauma, h/o asthma, on oral contraceptive pills and who are not willing to give consent for participation were excluded from the study. Sample size was calculated using the formula - $4pq/d^2$ and was 30.

Study variables included sociodemographic variables, chief presenting complaints, symptom scoring, anterior rhinoscopy findings, pre-operative peak nasal inspiratory flowmetry value, intraoperative findings, post-operative symptom scoring, post-operative inspiratory flowmetry values and post-operative nasal endoscopy findings.

Study tools included proforma, anterior rhinoscopy, peak nasal inspiratory flowmetry (PNIF) and nasal endoscopy. Patients less than 18 years were excluded from the study as there can be other causes of nasal obstruction like chronic adenoiditis. Also, patients less than 18 years and more than 60 years may not be able to take a peak inspiratory flow on flowmetry. History noted and symptoms scored on five-point scoring system (Based on SF36 Questionnaire)[2]

5-point scoring done for nasal obstruction, sneezing, running nose, itchy nose and stuffy nose (score 5 to 25).

- No symptoms (1)
- Mild symptoms without discomfort (2)
- Moderate symptoms with discomfort without impairment of daily activities (3)
- Moderately severe symptoms with impairment of daily activities (4)
- Severe symptoms with severe impairment in daily activities and or sleep (5)

Patients with a score of equal to or more than 4 of any of the two symptoms among sneezing, running nose, itchy nose and stuffy nose were diagnosed as allergic rhinitis and the rest as non-allergic rhinitis.[2] Total symptom scoring ranged from 5 to 25. After clinical examination, inferior turbinate hypertrophy was confirmed by nasal endoscopy. Pre-operatively peak inspiratory flowmetry was done for objective assessment of nasal patency. Face mask with seal was kept over nose with mouth closed. After maximal expiration patient sniffs air through the nose maximally and peak flow was recorded. Highest of three values taken as PNIF (peak nasal inspiratory flowmetry) value in L/minute (30 – 370 L/minutes). Value of less than 115 L/minute suggested significant obstruction.

Difference of 20 - 25 L/minute between pre-operative and post-operative values was considered significant. Laser spot of 4 watts power in repeat mode for a duration of 10 millisecond, three spots each applied over the anterior 1/3rd, middle 1/3rd and posterior 1/3rd of the enlarged inferior turbinate.

Nasal packing was not done in any of the patients. Patients were discharged on the next day of post-surgery. Patient was started on nasal douche on post-operative day. After CO_2 laser inferior turbinate reduction, patients were followed up after 1 week, 1 month and 3 months. During each follow up subjective assessment of improvement was done by symptom scoring.

Any increase in the score indicated poor outcome. During each follow up objective assessment was done by peak

inspiratory flowmetry and difference in pre-operative and post-operative values were noted. Difference of more than 25 L/minute indicated good outcome. Anterior rhinoscopy was done in each follow up visit to look for bleeding and crusting. Nasal douching was continued post-operatively for the next one month. Nasal endoscopy was also done at the end of 3rd month.

Figure 1a. Inspiratory Flow Meter

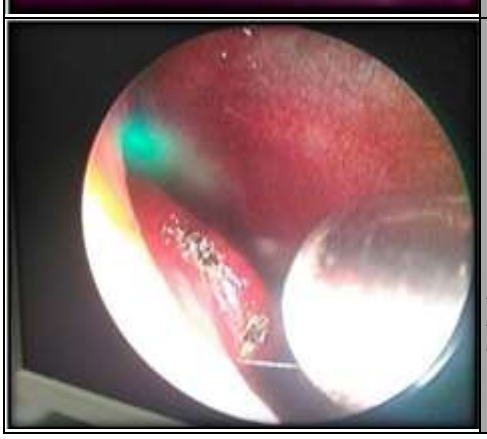

Figure1b. Laser Spots on the Turbinate

Statistical Analysis

The statistical analysis was performed using statistical package for social sciences (SPSS) version 16.0. Statistical tests used were repeated measures of analysis of variance (ANOVA).

RESULTS

Most patients belonged to age group 18 - 28 years. Majority of patients were females (58.1 %). Only two patients (wood dust and chemicals) among 31 patients had occupational exposure. Majority of patients (67.7 %). had allergic rhinitis. Only 25.8 % patients had hyposmia pre-operatively. 6.5 % patients had family history of allergic rhinitis. Majority of patients took steroid nasal spray for a period of 3 - 6 months (64.5 %) before surgery. Pre-operative symptom scoring was done via SF36 questionnaire French version with a minimum score of 5 and maximum score of 25. Pre-operatively most patients had score between 16 and 20 (41.9 %).

	Age in Years	Frequency	Percentage
Age category	18 - 28	17	54.8
	29 - 38	10	32.3
	39 - 48	2	6.5
	49 - 58	1	3.2
	More than 58	1	3.2
	Pre-operative Score	**Frequency**	**Percentage**
Pre-operative symptom scoring	5 - 10	6	19.4
	11 - 15	8	25.8
	16 - 20	13	41.9
	21 - 25	4	12.9

Table 1. Age Category and Pre-Operative Symptom Scoring

Pre-operatively, PNIF was done in all patients and since all had nasal obstruction, they had PNIF value below 115 L/minute. Most of them had value between 30 - 40 L/minute. Intraoperatively on applying laser spots minimal bleeding was present only in one patient. Post-procedure nasal packing was not done in any of the patients.

Pre-Operative Peak Nasal Inspiratory Flowmetry		
Pre-Operative PNIF (L/mt)	**Frequency**	**Percentage**
10 - 20	3	9.7
21 - 30	8	25.8
31 - 40	11	35.5
41 - 50	5	16.1
51 - 60	4	12.9

Table 2. Symptom Scoring on Follow Up

Symptom Score	Preop Score	Postop Score 1	Postop Score 2	Postop Score 3
5 - 10	6	24	29	29
11 - 15	8	7	2	2
16 - 20	13	0	0	0
21 - 25	4	0	0	0

Table 3. Pre-Operative Peak Nasal Inspiratory Flowmetry and Symptom Scoring on Follow Up

After CO_2 laser inferior turbinate reduction patients were followed up after 1 week, 1 month and 3 months. Pre-operative and post-operative symptom score analysis showed improvement in symptom score except two patients who had persistence of symptoms and hence poor outcome.

Peak nasal inspiratory flowmetry was done on each follow up and at the end of third month on all except two who had significant difference which was more than 25 L/minute. After treatment at the end of third month, subjective assessment was done by symptom scoring and objective assessment by flowmetry showed good outcome in 29 out of 31 patients (93.5 %).

Out of 8 patients with hyposmia, only one had persistence of symptom after three months. At first week of follow up, 48.4 % patients had nasal crusting and none of them had nasal bleeding on anterior rhinoscopy. Nasal douche was continued and at third month of follow up on anterior rhinoscopy none had nasal crusting. Nasal endoscopy was done at the end of third month and none of them had synechiae. At third month follow up after treatment, 35.7 % patients had relief from sneezing and 77.8 % had relief from running nose. From symptom scoring

done at the end of third month among the 31 patients who had nasal obstruction pre-operatively, 29 patients had relief and only two had persistence of nasal obstruction.

Repeated measures ANOVA testing was used to determine the significant change in symptom score before the procedure and during the follow up visits, which showed a P value of < 0.0001 which implies that there is a significant decrease in the symptom scores after the procedure during the follow up visits and there by significant subjective clinical improvement after the procedure.

Time(I)	Time(J)	Mean Difference (I - J)	Standard Error	p Value	95% Confidence Interval for Difference Lower Bound	Upper Bound
Pre-Operative Symptom Score	Symptom score at 1 week	7.774*	0.670	< .0001	5.882	9.667
	Symptom score at 1 month	9.065*	0.780	< .0001	6.861	11.268
	Symptom score at 3 months	9.484*	0.814	< .0001	7.185	11.782
Symptom Score at 1 Week	Pre-operative symptom score	-7.774*	0.670	< .0001	-9.667	-5.882
	Symptom score at 1 month	1.290*	0.374	< .0001.	0.233	2.348
	Symptom score at 3 months	1.710*	0.397	< .0001	0.589	2.830
Symptom Score at 1 Month	Pre-operative symptom score	-9.065*	0.780	< .0001	-11.268	-6.861
	Symptom score at 1 week	-1.290*	0.374	< .0001	-2.348	-0.233
	Symptom score at 3 months	.419*	0.111	< .0001	0.105	0.734
Symptom Score at 3 Months	Pre-operative symptom score	-9.484*	0.814	< .0001	-11.782	-7.185
	Symptom score at 1 week	-1.710*	0.397	< .0001	-2.830	-0.589
	Symptom score at 1 month	-.419*	0.111	< .0001	-0.734	-0.105

Table 4a. Pairwise Comparisons of Symptom Scores during the Study Period

(I) time	(J) time	Mean Difference (I - J)	Standard Error	P Value	95% Confidence Interval for Difference Lower Bound	Upper Bound
Pre-Operative PNIF	PNIF difference at 1week	-4.839*	2.974	0.6850	-13.239	3.561
	PNIF difference at 1 month	-14.839*	3.489	0.0011	-24.695	-4.982
	PNIF difference at 3rd month	-17.581*	3.781	0.0004	-28.260	-6.901
PNIF Difference at 1 Week	Pre-operative PNIF	4.839*	2.974	0.6850	-3.561	13.239
	PNIF difference at 1 month	-10.000*	1.751	<0.0001	-14.945	-5.055
	PNIF difference at 3rd month	-12.742*	2.305	<0.0001	-19.253	-6.230
PNIF Difference at 1 Month	Pre-operative PNIF	14.839*	3.489	0.0011	4.982	24.695
	PNIF difference at 1 week	10.000*	1.751	< 0.0001	5.055	14.945
	PNIF difference at 3rd month	-2.742*	1.156	0.1456	-6.006	0.522
PNIF Difference at 3rd month	Pre-operative PNIF	17.581*	3.781	0.0004	6.901	28.260
	PNIF difference at 1week	12.742*	2.305	< 0.0001	6.230	19.253
	PNIF difference at 1 month	2.742*	1.156	0.1456	-0.522	6.006

Table 4b. Pairwise Comparisons of PNIF Difference during the Study Period

Repeated measures ANOVA was done to find the significance of PNIF on follow up which showed a P value of < 0.0001 which implies that there is a significant increase in the PNIF value after the procedure during the follow up visits and there by significant objective clinical improvement after the procedure. There was a significant increase in the PNIF difference (more than 25 L/minute) after the procedure during the follow up visits. At the end of three months all except two had significant improvement. Among 31 patients, 21 had allergic rhinitis and 10 had non-allergic rhinitis. The success rate in clinical outcome was more in the non-allergic rhinitis (100 %) than the allergic rhinitis (90.47 %) group.

Marking - 0 means non-allergic rhinitis, 1 means allergic rhinitis. {X axis – pre-operative scoring (pre-score) and post-operative scoring on follow up at 1 week, 1 month and 3rd month (po-score1, po-score2, po-score3), Y axis - Score ranging from 5 to 25). Pre-operative symptom score was seen to be higher in allergic rhinitis group and both groups had decrease in symptom score post-operatively during follow up visits.

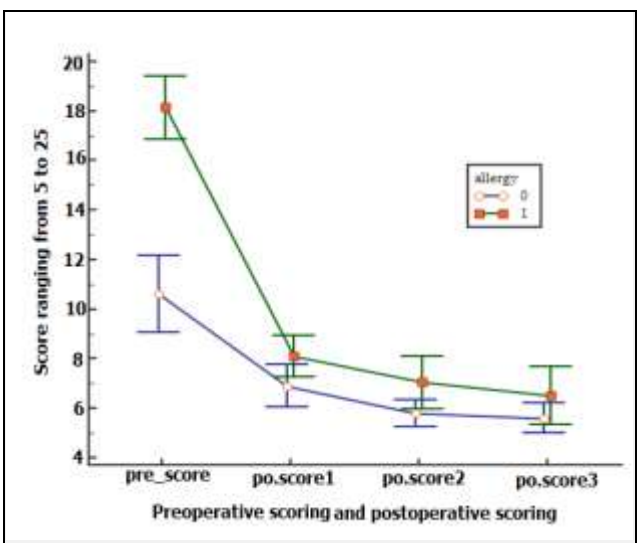

Figure 3. Trend of Post-Operative Symptom Score in Allergic Rhinitis and Non-Allergic Rhinitis Groups

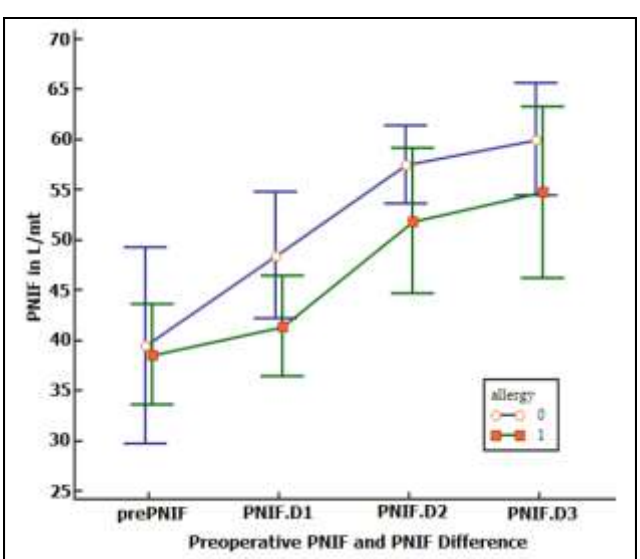

Figure 4. Trend of PNIF Difference in Allergic and Non-Allergic Patients during the Follow Up Visits

Marking - 0 means non-allergic rhinitis, 1 means allergic rhinitis. {X axis - Pre-operative PNIF and PNIF difference on follow up at 1 week, 1 month and 3rd month (PNIF-D1, PNIF-

D2, PNIF-D3), Y axis – PNIF in L/minute}. PNIF difference gradually increased in both allergic and non-allergic rhinitis groups on follow up visits. Both groups had significant difference in value (more than 25 L/minute), so the procedure is effective in both groups.

DISCUSSION

The present study was done to find out the clinical outcome of CO_2 laser inferior turbinate reduction in patients with nasal obstruction due to inferior turbinate hypertrophy. The results were compared and correlated with the studies conducted by other researchers. 31 patients with nasal obstruction due to inferior turbinate hypertrophy refractory to medical management who underwent laser inferior turbinate reduction were taken for the study. Most patients belonged to age category 18 - 28 (54.8 %). Mean age group was 30 years. Similar results were obtained in a study done by B.M. Lippert and J. A Wermer[3] were the mean age group was 36.3 years, and study done by Sabari Nath Vijayakumar et al.[6] was 34 years. In our study 58 % patients were females and rest were males. In a study by B.M Lippert and J. A Werner[3] on CO_2 laser inferior turbinate reduction, 55.9 % patients were females and another study done by Pradipta Kumar Parida[1] on diode laser inferior turbinate reduction 64.4 % patients were females. In the present study, 6.5 % had occupational exposure to allergens and both these patients had allergic rhinitis.

Pre-operatively symptoms scored on five-point scoring system (based on SF36 questionnaire). Any patient having a score of equal to or more than 4 for any of the two symptoms among sneezing, running nose, itchy nose and stuffy nose was taken as having allergic rhinitis and the rest as non-allergic rhinitis. Total symptom scoring ranged from 5 to 25. Mean pre-operative score was 15.7 and most patients had a score between 16 - 20 (41.9 %). Among 31 patients, 67.7 % had allergic rhinitis and 32.3 % had non-allergic rhinitis. Only 25.8 % of the total patients had hyposmia and 6.5 % patients had a family history of allergic rhinitis pre-operatively. Duration of medical treatment with steroid nasal sprays ranged from 3 months to 96 months and mean duration was 10.8 months. Patients with no relief in nasal obstruction after use of steroid nasal sprays for 3 months or more were considered refractory to medical treatment and were taken up for surgery.

Pre-operatively peak nasal inspiratory flowmetry was done for objective assessment of nasal patency. A study done by G. Ottaviano[4] on measurements of nasal airflow and nasal patency showed that PNIF is an important tool in the objective assessment of nasal obstruction. At the end of third month of follow up, among the 31 patients who had nasal obstruction pre-operatively, 93.5 % patients had relief from nasal obstruction. A study done by Pradipta Kumar Parida[1] on diode laser inferior turbinate reduction, 86.7 % patients had relief from nasal obstruction on follow up at 6 months. Study done by Sabari Nath Vijayakumar et al.[6] on potassium titanyl phosphate laser turbinate reduction, 73.33 % patients had relief from nasal obstruction at third month of follow up.

In this study, only two patients had persistence of nasal obstruction at third month of follow up. For these two patients, PNIF was done at the end of third month and had difference of less than 25 L/minute. So, at the end of third month after subjective assessment from symptom scoring and objective assessment by PNIF, 93.5 % patients had good outcome and 6.5 % patients had poor outcome. These two patients with poor outcome belonged to allergic rhinitis group. A study done by B.M Lippert[3] on CO_2 laser inferior turbinate reduction, 87.5 % patients on follow up had good outcome. In a study by Alessandro Vagnetti[7] on Nd: YAG laser for inferior turbinate hypertrophy, 85.9% patients had good outcome, 14 % patients had poor outcome and among patients with poor outcome 65 % patients had allergic rhinitis. Study by Serrano et al. on 46 patients treated by the holmium-YAG laser for chronic hypertrophic rhinitis. The results after only one laser session are satisfactory in 89.1% at 6 months follow-up and in 52.2% with mean follow-up of 16.2 months.[8] Study by Venkatesh Doreyawar et al. on inferior turbinate reduction, Diode laser versus conventional partial turbinectomy, outcomes with the diode laser were better and diode laser turbinate reduction caused less morbidity compared with the conventional technique.[9]

In the present study at third month of follow up, 77.8 % patients had relief from running nose. Relief in rhinorrhea and sneezing along with nasal obstruction may be attributed to destruction of highly vascular submucosa, seromucinous glands and incision of branches of posterior nasal nerve. Study done by Pradipta Kumar Parida[1] on diode laser inferior turbinate reduction at the end of 6 months, 86.7% patients had relief from rhinorrhea. In our study at third month of follow up on anterior rhinoscopy, none of the patients had nasal crusting or nasal bleeding. Similarly, a study done by Pradipta Kumar Parida[1] on diode laser inferior turbinate reduction, none of the patients had crusting at the end of follow-up. In our study nasal endoscopy was done at the end of 3 months and no synechiae was seen. Study done by Pradipta Kumar Parida[1,] there was no incidence of synechiae formation on 6 months follow-up after diode laser inferior turbinate reduction. In another study done to assess cytology of nasal mucosa, olfactometry and rhinomanometry in patients after CO2 laser mucotomy in inferior turbinate hypertrophy and three months after laser mucotomy nasal cytology showed decrease in goblet cells, olfactory function improved and rhinomanometry showed decrease in nasal resistance. CO2 laser mucotomy is an efficacious, minimally invasive and easy to use treatment of inferior turbinate hypertrophy.[10]

Repeated measures ANOVA testing was used to determine the significant change in symptom score before the procedure and during the follow up visits. Pairwise comparison was done with a P value of < 0.0001 which implies that there is a significant decrease in the scores after the procedure during the follow-up visits and there by significant subjective clinical improvement after the procedure. Study done by Pradipta Kumar Parida[1] on diode Laser inferior turbinate reduction, difference between the

pre-operative and follow up visual analogue scale (VAS) score was found to be statistically significant with a P value of < 0.0001.

Repeated measures ANOVA testing was used to determine the significant change in PNIF value before the procedure and during the follow-up visits. Pairwise comparison was done with a p value of < 0.0001 which implies that there is a significant increase in the PNIF value after the procedure during the follow up visits and there by clinical improvement after the procedure.

CONCLUSIONS

CO_2 laser inferior turbinate reduction is an effective procedure to relieve nasal obstruction in patients with inferior turbinate hypertrophy refractory to medical treatment. At the end of third month, post procedure after subjective assessment by symptom scoring and objective assessment by peak nasal inspiratory flowmetry, 93.5 % patients had good outcome with relief of nasal obstruction. Pair wise comparison of pre-operative and post-operative symptom scores and peak nasal inspiratory flowmetry difference by repeated measures ANOVA showed a P value < 0.0001. There was a significant decrease in the symptom scores and increase in flowmetry values after the procedure during the follow up visits. The success rate in clinical outcome was more in the non-allergic rhinitis (100 %) than the allergic rhinitis (90.47 %) group. This procedure can be done under local anaesthesia with minimal bleeding and hence can be performed as an office procedure. Along with nasal obstruction significant number of patients had relief from hyposmia, sneezing and running nose. In this study there was no nasal bleeding or synechiae formation on nasal endoscopy at third month of follow up post procedure.

Data sharing statement provided by the authors is available with the full text of this article at jebmh.com.
Financial or other competing interests: None.
Disclosure forms provided by the authors are available with the full text of this article at jebmh.com.

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