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Original Research Article

Temporal divergence in symptom relief after submucosal diathermy versus endoscopic partial inferior turbinectomy – a prospective randomized study in a central Indian tertiary care cohort

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ABSTRACT

Background: Inferior turbinate hypertrophy (ITH) is the commonest structural cause of chronic nasal obstruction. Submucosal diathermy (SMD) and endoscopic partial inferior turbinectomy (EPT) are both widely used, but their comparative outcome over time is incompletely characterized.
Methods: In this prospective, randomized, single-centre study, 100 adults with bilateral grade II-IV ITH refractory to medical therapy were randomized to SMD (n=50) or EPT (n=50). The nasal obstruction symptom evaluation (NOSE) score was recorded pre-operatively and at day 7, 1, 3 and 6 months; complications and operative time were recorded. t-tests and Chi-square/Fisher's exact test were used; $p<0.05$ was taken as significant.
Results: Groups were comparable for baseline NOSE score (74.10±8.19 versus 75.14±9.57; p=0.56). Improvement was equivalent at Day 7 (p=0.72) and 1 month (p=0.25). A significant divergence favouring EPT emerged at 3 months (31.32±5.42 versus 22.50±4.72; $p<0.0001$) and consolidated at 6 months (33.92±5.98 versus 7.54±2.53; $p<0.0001$), a 54.22% versus 89.97% reduction from baseline. EPT had greater early morbidity, including bleeding in 76% versus 2% of patients at Day 3, but every complication was self-limiting. Operative time was shorter with SMD (18.6±3.4 versus 27.8±5.1 minutes; $p<0.0001$). No atrophic rhinitis or empty nose syndrome occurred.
Conclusions: SMD and EPT gave equivalent short-term relief, but outcomes diverged from three months onward: SMD relapsed while EPT produced durable, near-complete resolution at the cost of transient early morbidity. Technique selection should be individualized to the patient and the predominant component of hypertrophy.

Keywords: Inferior turbinate hypertrophy, Submucosal diathermy, Endoscopic turbinectomy, Nasal obstruction, NOSE score

INTRODUCTION

The inferior turbinate is the principal regulator of nasal airflow and contributes to the warming, humidification and filtration of inspired air.[1] Its dense submucosal network of cavernous venous sinusoids underlies the dynamic change in turbinate size that constitutes the nasal cycle. Hypertrophy of the inferior turbinate (ITH) is the single most common structural cause of chronic nasal obstruction and arises from a range of pathologies including persistent allergic and vasomotor rhinitis, compensatory change secondary to septal deviation, chronic rhinosinusitis and rhinitis medicamentosa.[2]

Medical therapy-intranasal corticosteroids, second-generation antihistamines and saline irrigation-is first line. When obstruction persists because of a fibrous or bony component poorly responsive to medication, surgical reduction is indicated.[3] Numerous techniques exist, and surgical reduction of the inferior turbinate remains one of the most frequently performed procedures in otorhinolaryngology practice.[4] Submucosal diathermy

(SMD) and endoscopic partial inferior turbinectomy (EPT) are among the most widely practised. SMD was first described in 1951 and induces submucosal coagulation and delayed fibrosis while largely preserving the overlying mucosa, whereas EPT directly resects the inferior portion of the turbinate, removing bony and fibrotic components beyond the reach of coagulative fibrosis.[5,6]

Despite extensive use of both procedures, there is no firm consensus on which offers the better balance of durable relief and acceptable early morbidity, particularly in Grade III-IV disease.[7] Short-term outcomes are often indistinguishable, while medium-term outcomes have been reported to diverge in ways that are only partly understood.[8] We undertook this prospective randomised study to compare SMD and EPT using the validated nasal obstruction symptom evaluation (NOSE) score across four serial post-operative time points, with specific emphasis on the temporal trajectory of relief and the early complication profile.[9] SMD and EPT have been compared previously, including in an Indian cohort, but few prospective studies from the Indian subcontinent have tracked the serial NOSE-score trajectory across four post-operative time points; the present study addresses that gap in a central Indian tertiary-care cohort.[10]

METHODS

Study design and ethics

This prospective, randomised, comparative study was conducted in the Department of Otorhinolaryngology, Amaltas Institute of Medical Sciences (AIMS), Dewas, Madhya Pradesh, from March 2024 to August 2025, after approval by the institutional ethics committee and the scientific research committee, AIMS Dewas. The study conformed to the Declaration of Helsinki and the Indian Council of Medical Research National Ethical Guidelines for Biomedical and Health Research. Written informed consent in English or Hindi was obtained from every participant.

Participants

Patients presenting to the outpatient and inpatient services of the Department of Otorhinolaryngology, AIMS Dewas, with chronic nasal obstruction due to bilateral inferior turbinate hypertrophy were screened against the following criteria.

Inclusion criteria

Adults aged 18 years or older, of either sex; clinical diagnosis of bilateral hypertrophied inferior turbinate of grade II, III or IV on endoscopic assessment; nasal obstruction unresponsive to at least three months of adequate medical therapy comprising intranasal corticosteroids, second-generation antihistamines and saline irrigation; and patients with willingness to provide written informed consent and to comply with the scheduled follow-up visits were included.

Exclusion criteria

Patients with nasal polyposis, sinonasal tumour or any other space-occupying lesion of the nasal cavity; any patient unfit for surgery; known bleeding disorder, current anticoagulant therapy, or uncontrolled systemic illness (diabetes, hypertension, cardiac or renal disease); pregnancy or lactation; and patients with refusal to participate or to comply with follow-up were excluded.

Sample size and randomization

Using the standard formula for comparison of two independent means, with α=0.05 (two-tailed), power=80%, a pooled standard deviation of the NOSE score of 12 (from published literature) and a minimum clinically meaningful difference of 8 points, the minimum requirement was 36 per group; this was rounded up to 50 per group (100 total) to allow for attrition and to strengthen subgroup robustness. Eligible patients were allocated by computer-generated block randomisation (block size four) with allocation concealment in sequentially numbered, sealed opaque envelopes opened only after consent and admission for surgery.

Surgical technique

All procedures were performed under general anaesthesia. In group A (SMD), after decongestion with 4% xylocaine and 1:10,000 adrenaline, an insulated bipolar diathermy needle was advanced submucosally from the anterior end of the inferior turbinate and a standardised bipolar current (15-20 W) delivered along two to three parallel tracks, remaining within the submucosa to spare the mucosa. In group B (EPT), after decongestion and infiltration with 2% xylocaine and 1:200,000 adrenaline, the inferior one-third to one-half of the turbinate was resected under 0° endoscopic guidance using turbinectomy scissors and Blakesley forceps (microdebrider where available), preserving medial mucosa to avoid over-resection.

Haemostasis was confirmed endoscopically; a Merocel nasal pack was placed for 24-48 hours in EPT where required.

Outcome measures and follow-up

The primary outcome was the change from baseline in NOSE score at day 7, 1, 3 and 6 months. Secondary outcomes were the incidence and severity of bleeding, pain, crusting and synechiae (each graded as absent, mild, moderate or severe at every visit); mean operative time; and the occurrence of atrophic rhinitis or empty nose syndrome. All 100 enrolled patients completed the six-month follow-up protocol; none was lost to follow-up.

Statistical analysis

Data were analysed using statistical package for the social sciences (SPSS) software, version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables are expressed as mean ± standard deviation and were compared using the paired t-test (intra-group) and the unpaired t-test (inter-group). Categorical variables are expressed as frequencies and percentages and were compared using the Chi-square test, with Fisher's exact test applied where expected cell counts were small. A two-sided p value of less than 0.05 was considered statistically significant.

RESULTS

Baseline characteristics

One hundred patients (50 per group) were enrolled and completed follow-up. The two groups were comparable for sex distribution, duration of symptoms, grade of hypertrophy and pre-operative NOSE score (Table 1). Grade III-IV disease accounted for 95% of the cohort. A statistically significant difference in mean age was observed between groups (32.56±11.51 years in SMD versus 39.52±14.01 years in EPT; p=0.0102); the clinical relevance of this difference is addressed in the discussion.

Table 1: Baseline characteristics of the two study groups.

Variables	SMD (n=50)	EPT (n=50)	P value
Mean age (years)	32.56±11.51	39.52±14.01	0.0102
Male: female	26:24	28:22	0.841
Grade III-IV ITH	48 (96%)	47 (94%)	-
Symptom duration (years)	2.4±1.1	2.6±1.3	0.4120
Pre-operative NOSE score	74.10±8.19	75.14±9.57	0.5607

ITH: Inferior turbinate hypertrophy; NOSE: nasal obstruction symptom evaluation; SMD: submucosal diathermy; EPT: endoscopic partial inferior turbinectomy

NOSE-score trajectory

Both groups improved markedly and statistically equivalently in the early post-operative period: at day 7 (55.34±6.72 versus 55.82±6.54; p=0.7182) and at 1 month (27.10±4.99 versus 28.30±5.27; p=0.2454). A significant divergence favouring EPT emerged at 3 months, when the SMD group showed early symptomatic recurrence while the EPT group continued to improve (31.32±5.42 versus 22.50±4.72; p<0.0001). By 6 months the gap had widened further (33.92±5.98 versus 7.54±2.53; p<0.0001), corresponding to a 54.22% reduction from baseline with SMD versus 89.97% with EPT (Table 2). Intra-group improvement from baseline was significant at every time point in both groups (paired t-test, p<0.0001 throughout), but the trajectories diverged sharply after the one-month visit.

Table 2: NOSE score at each post-operative time point.

Time points	SMD (mean±SD)	EPT (mean±SD)	P value
Pre-operative	74.10±8.19	75.14±9.57	0.5607
Day 7	55.34±6.72	55.82±6.54	0.7182
1 month	27.10±4.99	28.30±5.27	0.2454
3 months	31.32±5.42	22.50±4.72	<0.0001
6 months	33.92±5.98	7.54±2.53	<0.0001
% reduction at 6 months	54.22%	89.97%	<0.0001

Inter-group comparison by unpaired t-test. Intra-group improvement from baseline was significant at every time point in both groups (paired t-test, p<0.0001)

Operative characteristics

Mean operative time was significantly shorter with SMD than with EPT (18.6±3.4 versus 27.8±5.1 minutes; p<0.0001). Estimated intra-operative blood loss was minimal with SMD (under 5 ml in the majority of cases) and modest with EPT (15-25 ml in the majority of cases), consistent with the resective nature of the latter procedure.

Table 3: Comparative complication profile and operative outcomes.

Parameters	SMD	EPT	P value	Favo-urs
Bleeding at day 3	1/50 (2%)	38/50 (76%)	<0.0001	SMD
Bleeding at day 7	0/50 (0%)	21/50 (42%)	<0.0001	SMD
Pain at day 7 (any)	0/50 (0%)	32/50 (64%)	<0.0001	SMD
Crusting at day 7	21/50 (42%)	40/50 (80%)	0.0002	SMD
Synechiae at day 7	0/50 (0%)	7/50 (14%)	0.0125	SMD
NOSE at 6 months	33.92±5.98	7.54±2.53	<0.0001	EPT
Operative time (min)	18.6±3.4	27.8±5.1	<0.0001	SMD
Atrophic rhinitis/ ENS	0	0	-	-

ENS, empty nose syndrome. Categorical comparisons by Chi-square or Fisher's exact test as appropriate. Every complication observed was self-limiting and managed conservatively without re-intervention.

Complications

Early post-operative morbidity was consistently higher after EPT (Table 3). Bleeding at Day 3 occurred in 76% of EPT versus 2% of SMD patients ($p<0.0001$), and persisted in 42% versus 0% at day 7, resolving in both groups by 6 months. Moderate-to-severe pain on the day of surgery affected 78% of EPT versus 14% of SMD patients; by day 7 all SMD patients were pain-free while 64% of EPT patients still reported residual pain ($p<0.0001$), falling to 14% by 1 month. Crusting at day 7 was present in 80% of EPT patients (predominantly moderate) versus 42% of SMD patients (predominantly mild; $p=0.0002$). Synechiae occurred exclusively after EPT (14% at day 7; $p=0.0125$) and all resolved spontaneously or with minor office-based division by the 1-month visit. No patient in either group required re-intervention, re-packing or blood transfusion, and no patient developed atrophic rhinitis or empty nose syndrome during the six-month follow-up.

DISCUSSION

The principal finding of this study is not which procedure is superior in absolute terms, but when and why the two techniques diverge. For the first post-operative month, SMD and EPT were statistically indistinguishable, with both moving patients from severe to mild obstruction. The trajectories separated at three months, when EPT continued towards resolution while SMD relapsed, and the separation became decisive by six months (89.97% versus 54.22% reduction from baseline). A patient counselled only on one-month outcomes would therefore be materially misled about the durability of SMD.

This temporal pattern is biologically coherent. SMD reduces turbinate volume through coagulative submucosal fibrosis and vascular sclerosis, constraining the erectile tissue mechanically while leaving the underlying stromal and glandular drivers of hypertrophy largely intact. As physiological healing proceeds-neovascularisation and re-innervation-the residual tissue can re-expand, particularly under ongoing inflammatory or allergic stimulus. EPT, by excising the inferomedial bone and hypertrophic submucosa, removes the structural substrate for re-expansion, which plausibly accounts for its durable result. Our findings are concordant with the comparative literature: Passali et al demonstrated durable benefit from mucosa-preserving submucosal resection with progressive recurrence after thermal-only approaches in a six-year multicentre trial; Fradis et al reported a 17.6% re-operation rate within one year of SMD; Joniau et al observed cauterisation-related turbinate re-expansion at five years while powered turbinoplasty remained patent; and a 2025 meta-analysis by Camacho et al found that excisional techniques sustained 80-83% of their improvement at three years, while non-excisional thermal techniques drifted back towards baseline.[11-13] Elshipli et al similarly found submucous resection superior to combined diathermy and outfracture on long-term assessment.[14]

Durability with EPT came at the price of greater early morbidity-more bleeding, pain, crusting and synechiae-consistent with its resective nature and the division of vascular structures including branches of the sphenopalatine artery and the submucosal venous plexus. This is consistent with Fradis et al, who reported a substantially higher bleeding rate after turbinectomy than after SMD.[15] Importantly, this morbidity was transient and self-limiting in our series: no patient required re-intervention, re-packing or transfusion, and there were no cases of atrophic rhinitis or empty nose syndrome. This favourable safety profile reflects deliberate surgical restraint-resecting only the inferior one-third to one-half of the turbinate while preserving medial mucosa-consistent with evidence that empty nose syndrome follows total or radical, rather than conservative partial, turbinectomy.[16] SMD, conversely, retains genuine advantages: a near-zero bleeding rate, faster recovery and a significantly shorter operative time, making it well suited to outpatient settings and to patients with bleeding diatheses or on anticoagulants.

Two further points merit comment. First, our 6-month EPT outcome (NOSE 7.54±2.53) approached the normative, asymptomatic population value reported by Shastri et al, while the SMD outcome (33.92±5.98) remained above the obstruction threshold of 30 proposed by Lipan et al and exceeded the patient-centred minimum important difference described by Ziai and Bonaparte, underscoring that the residual symptom burden after SMD at six months was not merely statistically but clinically significant. Second, a comparable Indian cohort study by Al-Zobair et al and the broader literature reviewed by Bhandarkar et al and by De Corso et al similarly describe symptomatic relapse after thermal-only techniques on extended follow-up, reinforcing that our findings reflect a generalisable biological phenomenon rather than a centre-specific artefact.[17-22]

The clinical implication is a trade-off to be matched to the patient rather than a universal preference for one technique. SMD remains reasonable for predominantly mucosal or vascular hypertrophy, for patients prioritising minimal morbidity, and for those with bleeding diatheses or on anticoagulants, provided they are counselled that symptoms may recur within three to six months. EPT should be preferred for grade III-IV or mixed bony-mucosal disease and for patients seeking durable, definitive relief, with frank pre-operative counselling about the higher-though transient-early morbidity.

Strengths and limitations

Strengths of this study include the prospective randomised design, an adequate and equal group size, a validated patient-reported outcome measure administered at four serial post-operative time points, a standardised surgical protocol, and comprehensive complication documentation with formal statistical testing throughout. Limitations include a six-month follow-up horizon, which cannot fully

define either the ultimate extent of SMD recurrence or the long-term durability of EPT; reliance on a subjective outcome measure without objective rhinomanometric or acoustic rhinometric confirmation; the absence of histopathological examination of excised tissue, so that the relative bony versus soft-tissue contribution to hypertrophy could not be confirmed; the single-centre design, which limits generalisability; and non-blinding of the operating surgeons. A statistically significant age difference persisted between groups despite randomisation; however, baseline NOSE scores were equivalent between groups, the older EPT group would, if anything, be expected to fare no better on age grounds alone, and the magnitude of the observed efficacy difference far exceeds any plausible age-related variation in surgical response.

CONCLUSION

In grade II-IV inferior turbinate hypertrophy, SMD and EPT produce statistically equivalent short-term symptom relief, but their outcomes diverge from three months onward: SMD shows early symptomatic recurrence, whereas EPT delivers durable, near-complete resolution by six months. This durability is offset by greater-though transient and self-limiting-early morbidity and a longer operative time with EPT. Neither technique is universally superior; the choice should be individualised on the basis of the predominant component of hypertrophy, the patient's tolerance for early morbidity, and their preference between minimal recovery time with a realistic possibility of recurrence (SMD) and a longer recovery with durable resolution (EPT). Honest pre-operative counselling on this trade-off remains the most important step in matching the right technique to the right patient.

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