

Prelacrimal Recess Approach for Benign Maxillary Sinus Disease

Anubha Mangla¹, Nitish Kumar¹, Ishwar Singh¹, Ravi Meher¹

1. Otolaryngology - Head and Neck Surgery, Maulana Azad Medical College, New Delhi, IND

Corresponding author: Anubha Mangla, anubha25199@gmail.com

Review began 09/28/2026

Review ended 10/13/2026

Published 10/19/2026

© Copyright 2026

Mangla et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

DOI: 10.7759/cureus.118165

Abstract

Background: The conventional middle meatal antrostomy provides limited access to the anterior, lateral and inferior walls of the maxillary sinus, potentially leaving behind residual disease. The prelacrimal recess approach may offer improved anterior access while preserving the nasolacrimal duct and inferior turbinate. This study assessed the short-term (one-month) feasibility of the prelacrimal recess approach in benign maxillary sinus disease with extensive polyposis, where access to the anterolateral wall of the maxillary sinus is required.

Materials and methods: Twenty adults with benign maxillary sinus pathology underwent endoscopic surgery using the prelacrimal recess approach in this prospective interventional study. Preoperative computed tomography and visual analogue scale scoring were performed. Nasal endoscopy and visual analogue scale (VAS) scores were repeated at one month.

Results: All maxillary sinus walls could be visualised in all patients. Allergic fungal rhinosinusitis was the most common diagnosis (11 patients, 55%), followed by antrochoanal polyp (four patients, 20%). The median VAS score improved from 8 preoperatively to 2 at one month (Wilcoxon signed-rank test, $Z = -3.92$, $p < 0.001$; $r = 0.88$). No patient developed epiphora, cheek numbness, or nasolacrimal duct injury. Two patients (10%) developed synechiae. Early disease persistence/relapse at one month was observed in two patients (10%), both with chronic rhinosinusitis with nasal polyposis.

Conclusion: The prelacrimal recess approach may be a feasible option for access to the anterolateral aspects of the maxillary sinus, with symptom improvement and low morbidity observed in this small series. Larger studies with longer follow-up are needed.

Categories: Otolaryngology, Anatomy

Keywords: allergic fungal rhinosinusitis, antrochoanal polyp, chronic rhinosinusitis with polyposis, endoscopic sinus surgery, maxillary sinus disease, middle meatal antrostomy, nasolacrimal duct preservation, prelacrimal recess approach

Introduction

The maxillary sinus is among the most commonly operated paranasal sinuses. In routine functional endoscopic sinus surgery (FESS), access to the maxillary sinus is achieved through the middle meatus antrostomy (MMA), which generally provides adequate exposure of the posterior and medial walls. However, access to the anterior, lateral, and inferior walls remains limited, contributing to possible postoperative residual disease and symptom persistence or recurrence [1]. Maxillary sinus diseases requiring wider access are frequently encountered in the Indian subcontinent, particularly in the form of allergic fungal rhinosinusitis (AFRS) and antrochoanal (AC) polyps, making the restricted access with MMA even more problematic in this densely populated geographical region.

Historically, external approaches such as the Caldwell-Luc procedure or medial maxillectomy were used when wider exposure to the maxillary sinus was considered necessary. Although these techniques allow good visualisation of the sinus cavity, they are associated with well-documented morbidity, including cheek numbness, dental paraesthesia, facial swelling, and injury to the nasolacrimal duct (NLD) [2].

With the gradual shift towards minimally invasive surgery, there has been an increasing interest in endoscopic techniques that improve access to the maxillary sinus compared to the conventional MMA, while preserving neighbouring nasal structures and reducing postoperative morbidity.

The prelacrimal recess lies anterior to the NLD and provides a relatively direct corridor into the maxillary sinus. The prelacrimal recess approach (PLRA) preserves the NLD as well as the inferior turbinate and is reported to allow straight-line visualisation of all walls of the maxillary sinus [3]. When combined with access through the natural ostium, it also permits two-portal instrumentation. The safety and feasibility of this approach have been demonstrated in anatomical and cadaveric studies [4]. However, published clinical data evaluating the use of the PLRA in the Indian setting remain limited.

How to cite this article

Mangla A, Kumar N, Singh I, et al. (October 19, 2026) Prelacrimal Recess Approach for Benign Maxillary Sinus Disease. Cureus 18(10): e118165. DOI 10.7759/cureus.118165

This study was conducted to assess the feasibility of the PLRA, with short-term (one-month) outcomes, in addressing maxillary sinus conditions with extensive polyposis, such as AFRS or AC polyp, where access to the anterolateral wall of the maxillary sinus is required, in an Indian tertiary care centre. Primary outcomes included intraoperative visualisation and disease clearance, while secondary outcomes focused on postoperative symptom relief, complications, and early disease persistence/relapse at one month.

Materials And Methods

Study design and setting

This prospective interventional study was conducted in the Department of Otorhinolaryngology-Head and Neck Surgery at a tertiary care teaching hospital after approval from the Institutional Ethics Committee (IEC No. F.1/IEC/MAMC/MD/MS (108/01/2024/No.106), dated April 3, 2024).

Study population

From June 2024 to June 2025, adult patients (18–60 years) presenting to the ENT outpatient department (OPD) with benign maxillary sinus pathologies (AC polyp, chronic rhinosinusitis with nasal polyposis (CRSwNP) or without nasal polyposis (CRSsNP) [5], AFRS, and maxillary sinus fungal ball) requiring surgical intervention were included. AFRS was diagnosed using the criteria of Bent and Kuhn [6]. Patients with malignant sinonasal disease, extensive bony destruction of the prelacrima recess region, significant facial trauma altering local anatomy, or those undergoing revision maxillary sinus surgery were excluded to reduce confounding variables due to prior surgery and allow a more standardised evaluation of the surgical technique and its outcomes. Patients with less than one month postoperative follow-up were also excluded. No formal sample size calculation was performed prior to the study; all consecutive patients meeting the inclusion criteria during the study period were enrolled.

Preoperative evaluation

All patients underwent diagnostic nasal endoscopy. Preoperative visual analogue scale (VAS) [7] score was recorded, reflecting the patient's subjective assessment of the overall severity of sinonasal disease. The VAS is a freely available, non-copyrighted assessment tool and required no permission for use in this study. Non-contrast computed tomography (CT) of the paranasal sinuses was performed to determine disease extent and to evaluate the anatomical relationship between the anterior wall of the maxilla and the NLD, thereby assessing feasibility of the PLRA. The distance between the anterior wall of the maxilla and the anterior wall of the NLD was measured on axial CT images in all patients (Figure 1), and a distance of more than 3 mm was considered suitable for the PLRA, in accordance with the Simmen classification [8].



FIGURE 1: Preoperative CT assessment of the prelacrimal recess in a patient with allergic fungal rhinosinusitis

Axial non-contrast CT of the paranasal sinuses (bone window) showing measurement of the distance between the anterior wall of the maxilla and the anterior wall of the nasolacrimal duct (NLD) on the right side (6.37 mm).

Surgical technique

The PLRA technique used in this study was adopted from the approach originally described by Zhou et al., with modifications as detailed below [3]. The surgical steps are detailed as follows. Surgery was performed by the senior author (R.M.) in all study patients. Surgery was performed under general anaesthesia with the patient in a reverse Trendelenburg position (15 degrees head-end elevation). Nasal decongestion was achieved using 1:1000 adrenaline-soaked cotton patties. Diagnostic endoscopy was re-performed, confirming the pre-operative findings (Figure 2A), and septoplasty was undertaken when required to improve surgical access.

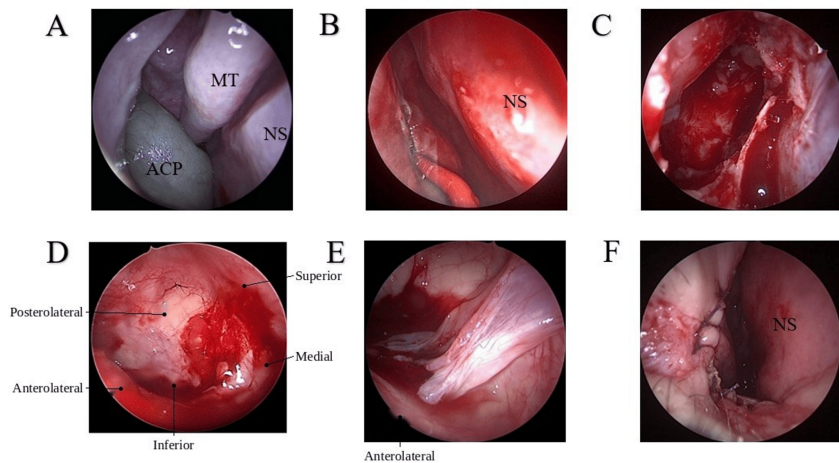


FIGURE 2: Endoscopic intraoperative images from the PLRA surgery

(A) Endoscopic view of an ACP occupying the nasal cavity; (B) prelacrimal incision placed at the anterior end of the inferior turbinate; (C) widened prelacrimal window over the medial wall of the maxillary sinus; (D) endoscopic entry into the maxillary sinus through the prelacrimal recess demonstrating complete visualisation of all walls of the maxillary sinus (labelled: superior, medial, inferior, anterolateral and posterolateral walls); (E) visualisation of attachment of the stalk of ACP to the anterolateral wall of the maxillary sinus; (F) sutured inferior turbinate flap on the right side following completion of PLRA.

ACP: antrochoanal polyp; MT: middle turbinate; NS: nasal septum; PLRA: prelacrimal recess approach.

Surgery began with FESS, including a wide MMA and as much clearance of the sinus disease as possible. Following this, the PLRA was performed. A mucosal incision was placed at the anterior end of the inferior turbinate using monopolar cautery with a bent tip (Figure 2B), and a subperiosteal flap including the head of the inferior turbinate was carefully elevated to expose the anteromedial wall of the maxillary sinus, staying anterior to the expected course of the NLD.

A bony window was created anterior to the expected course of the NLD using powered instrumentation (Stryker cutting burr (Stryker Corporation, Kalamazoo, Michigan, USA), 2 to 3 mm), providing access to the maxillary sinus through the prelacrimal corridor (Figure 2C). The anterior limit of the bony window was the piriform aperture, and bone removal was kept anterior and adjacent to it, away from the expected course of the NLD. Endoscopic visualisation was achieved using 0°, 30°, and 70° rigid endoscopes, allowing systematic inspection of the anterolateral, posterolateral, medial, superior, and inferior walls of the maxillary sinus (Figure 2D). Disease clearance was performed using angled forceps, suction instruments, and microdebriders. Working was bidirectional, with the endoscope placed through the MMA and instruments through the prelacrimal window, or the reverse, as required. In cases of AC polyp, the site of attachment was directly visualised and excised (Figure 2E).

Following completion of the procedure, haemostasis was secured, and the mucosal flap was repositioned and sutured with two Vicryl 3-0 sutures (Ethicon Inc., Raritan, New Jersey, USA) (Figure 2F). Non-absorbable nasal packing was performed when required.

Postoperative care and follow-up

When used, non-absorbable nasal packs were removed on the second postoperative day (approximately 48 hours after surgery). Postoperative management included a short course of oral amoxicillin-clavulanate (seven days), with regular saline nasal irrigation, intranasal corticosteroid spray, and oral antihistamines prescribed for approximately four weeks. Endoscopic examination was performed weekly to assess healing, remove crusts, and identify complications. Postoperative VAS scores were recorded at one month and compared with preoperative values. The observation of frank polyps in the middle meatus arising from the maxillary sinus at one month after surgery was considered early disease persistence/relapse of maxillary sinus disease.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics software for Windows (version 25.0; IBM Corp., Armonk, New York, USA). Normality of continuous data was assessed using the Shapiro-Wilk test. As VAS scores demonstrated a non-normal distribution and represented subjective ordinal data, non-parametric statistical methods were used. Age was expressed as mean $\pm$ standard deviation and VAS scores as median and interquartile range (IQR), while categorical variables were expressed as frequencies and percentages.

Comparison between preoperative and postoperative VAS scores was performed using the Wilcoxon signed-rank test, with the rank-based correlation coefficient (r) as the effect size. Associations between categorical variables were assessed using the Fisher-Freeman-Halton exact test for contingency tables larger than two by two and Fisher's exact test for two-by-two tables, as expected cell counts were below five. Effect sizes were reported as Cramér's V , the phi coefficient, or an odds ratio with a 95% confidence interval, using the Haldane-Anscombe continuity correction where a cell contained zero. A p -value of <0.05 was considered statistically significant.

Results

Patient characteristics

Twenty patients diagnosed with benign maxillary sinus disease underwent surgical management using the PLRA and were included in the final analysis. All patients completed the required one-month postoperative follow-up. Demographic and clinical details are summarised in Table 1.

Characteristic	Observation/value	Test statistic
Study population	20 patients	—
Age, years, mean $\pm$ standard deviation	36.05 years (± 13.46)	—
Sex, male	13 (65%)	—
Sex, female	7 (35%)	—
Laterality of sinus disease, unilateral	14 (70%)	—
Laterality of sinus disease, bilateral	6 (30%)	—
Primary diagnosis, AFRS	11 (55%)	—
Primary diagnosis, AC polyp	4 (20%)	—
Primary diagnosis, CRSwNP	3 (15%)	—
Primary diagnosis, CRSsNP	1 (5%)	—
Primary diagnosis, fungal ball	1 (5%)	—
Associated DNS	6 patients (30%)	—
Presenting symptoms, nasal obstruction	20 (100%)	—
Presenting symptoms, nasal discharge	7 (35%)	—
Presenting symptoms, epistaxis	1 (5%)	—
Procedure performed, FESS + PLRA (without endoseptoplasty)	14 (70%)	—
Procedure performed, FESS + PLRA + endoseptoplasty	1 (5%)	—
Procedure performed, MMA + PLRA (without endoseptoplasty)	2 (10%)	—
Procedure performed, MMA + PLRA + endoseptoplasty	3 (15%)	—
Association between procedure type and diagnosis	$p = 0.002$	Fisher–Freeman–Halton exact test (reference $\chi^2(12) = 23.85$); Cramér's $V = 0.631$ (95% CI 0.067–0.750)
Preoperative VAS, median (IQR)	8 (7.75-9)	—
Postoperative VAS at 1 month, median (IQR)	2 (1-3)	—
	Wilcoxon signed-rank test; $p < 0.001$;	

Statistical analysis for VAS improvement	median reduction 6.0 points (95% CI 5.5–6.5)	Z = -3.92, r (effect size) = 0.88
Postoperative complications, cheek numbness	0 (0%)	—
Postoperative complications, epiphora/NLD injury	0 (0%)	—
Postoperative complications, synechiae	2 (10%)	—
Association between synechiae and procedure type	p = 0.047	Fisher–Freeman–Halton exact test (reference $\chi^2(3)$ = 12.59); Cramér’s V = 0.793 (95% CI 0.245–1.000)
Early disease persistence/relapse at one month	2 patients (10%)	—
Association with early disease persistence/relapse at one month	Observed exclusively in CRSwNP patients (p = 0.016)	Fisher’s exact test; Haldane-corrected OR = 58.3 (95% CI 1.83–1864); ϕ = 0.793
Follow-up duration	1 month	—

TABLE 1: Demographic, clinical, operative, and outcome characteristics of the study cohort

AFRS: allergic fungal rhinosinusitis; AC polyp: antrochoanal polyp; CRSwNP: chronic rhinosinusitis with nasal polyposis; CRSsNP: chronic rhinosinusitis without nasal polyposis; DNS: deviated nasal septum; FESS: functional endoscopic sinus surgery; MMA: middle meatal antrostomy; PLRA: prelacrima recess approach; NLD: nasolacrimal duct; VAS: visual analogue scale; IQR: interquartile range; OR: odds ratio; CI: confidence interval.

Tests used: Wilcoxon signed-rank test for preoperative versus postoperative VAS; Fisher–Freeman–Halton exact test for procedure type versus diagnosis and synechiae versus procedure type; Fisher’s exact test for early disease persistence/relapse versus CRSwNP. Z, standardised Wilcoxon statistic; r, rank-based effect size; χ^2 , reference chi-square value (degrees of freedom in parentheses); ϕ , phi coefficient; OR is Haldane–Anscombe corrected.

A dash (—) indicates that no test was applicable.

Clinical presentation

Nasal obstruction was reported by all patients at presentation. Nasal discharge and epistaxis were less frequently reported (Table 1).

Disease distribution

Maxillary sinus disease was unilateral in the majority of patients, with bilateral involvement in six patients (30%) (Table 1).

Diagnostic profile

AFRS was the most frequent diagnosis, followed by AC polyp and CRSwNP. CRSsNP and fungal ball were each identified in one patient. Deviated nasal septum (DNS) was a common associated finding (Table 1).

Surgical management

The majority of patients underwent FESS combined with PLRA. A smaller proportion required MMA with PLRA, with or without concurrent endoseptoplasty. The type of surgical procedure demonstrated a statistically significant association with the underlying diagnosis (p = 0.002; Fisher–Freeman–Halton exact test, Cramér’s V = 0.631), with AFRS patients more frequently requiring extensive FESS, and AC polyp patients commonly managed with MMA combined with PLRA (Table 1).

Intraoperative visualisation

Using the PLRA, complete visualisation of all five walls of the maxillary sinus - anterolateral, posterolateral, medial, superior, and inferior - was achieved in all 20 patients (100%). Straight (0°) endoscopes allowed adequate assessment of the medial, inferior, and posterior walls, while angled endoscopes (30° and 70°) were necessary to inspect the anterior and lateral walls, which were relatively difficult to assess through the MMA alone.

Symptom severity outcomes

VAS scores demonstrated a statistically significant reduction following surgery (Wilcoxon signed-rank test,

$p < 0.001$), as detailed in Table 1 and Figure 3.

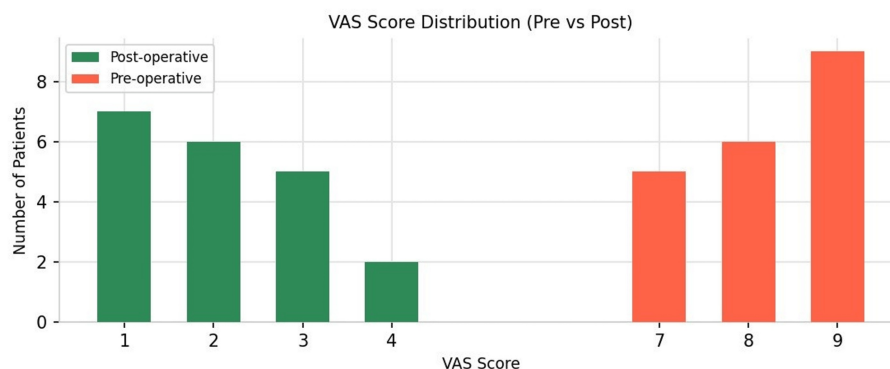


FIGURE 3: Bar chart showing distribution of VAS scores in patients before and after surgery

Postoperative morbidity

No major postoperative complications were recorded. No patient experienced cheek numbness or epiphora. Two patients (10%) developed postoperative synechiae, which were managed with office-based endoscopic synechiolysis. A statistically significant association was observed between synechiae and the type of surgical procedure performed ($p = 0.047$ (Fisher-Freeman-Halton exact test, Cramér's $V = 0.793$)). Given the small number of events ($n = 2$), this association should be interpreted as exploratory.

Early disease persistence/relapse at one month

Early disease persistence/relapse at one month was identified in two patients (10%), both diagnosed with CRSwNP. A statistically significant association was found between CRSwNP and early disease persistence/relapse at one month (Fisher's exact test, $p = 0.016$; Haldane-corrected OR = 58.3, 95% CI 1.83–1864). Given only two events, this association is exploratory and should be interpreted with caution. As follow-up was limited to one month, these findings represent early disease persistence or treatment failure rather than true long-term recurrence.

Discussion

The PLRA has gained recognition as a minimally invasive endoscopic corridor that may allow wider access to the maxillary sinus, particularly to regions that are inadequately visualised using conventional MMA [9]. In this prospective study of benign maxillary sinus disease, use of the PLRA was feasible, with surgical exposure of the anterolateral wall, disease clearance, symptomatic improvement at one month, and a low complication rate in this small series [10].

A principal finding of this study was the achievement of complete intraoperative visualisation of all five walls of the maxillary sinus in every patient [3]. This observation is clinically relevant, as the anterior and lateral walls of the maxillary sinus are commonly difficult to access through standard endoscopic MMA owing to the posteromedial location of the natural maxillary ostium [11]. Although angled endoscopes may improve visualisation through the middle meatus, access remains limited and technically demanding [12]. By creating an anterior entry point into the maxillary sinus, the PLRA provides a direct line of sight into the sinus cavity, allowing wider visualisation and improved instrument manoeuvrability [13]. This anatomical advantage may explain the uniform visualisation achieved in the present series and suggests a possible advantage of the approach in selected cases [14].

In addition to enhanced visualisation, the approach appeared to facilitate clearance of disease from the maxillary sinus [15]. The ability to alternate visualisation and instrumentation between the prelacral window and the natural ostium improved surgical flexibility, particularly for anteriorly located pathology. This bidirectional working capability may contribute to more thorough disease removal while preserving surrounding mucosa, a feature that is particularly relevant in benign but potentially recurrent conditions [16].

The demographic profile of patients in this study reflects commonly reported patterns in benign sinonasal disease. Most patients presented in the third to fifth decade of life, with a male predominance. Nasal obstruction was the most frequent presenting complaint, followed by nasal discharge and epistaxis, consistent with the obstructive nature of maxillary sinus pathology. The diagnostic profile in this study is consistent with patterns commonly reported in the Indian subcontinent. Septal deviation, when present,

influenced surgical planning and necessitated endoseptoplasty in selected cases to optimise access, a practice supported by prior reports [17].

Surgical management was tailored according to disease extent and pathology. Diffuse inflammatory conditions such as CRSwNP required comprehensive FESS in addition to the PLRA, whereas localised disease could be adequately addressed with targeted maxillary intervention. The significant association between diagnosis and type of procedure performed underscores the importance of individualised surgical planning rather than a uniform operative strategy [5].

Postoperative symptom assessment demonstrated a statistically significant reduction in symptom severity at one-month follow-up. The consistency of improvement across diagnostic categories suggests, within the limits of this small series and short follow-up, that the benefits of the PLRA may extend beyond anatomical access alone. Similar improvements in patient-reported symptoms have been described in previous studies evaluating this approach [18].

From a safety perspective, the PLRA was associated with minimal morbidity in the present study. No patients developed epiphora or cheek numbness, complications traditionally associated with more destructive anterior maxillary approaches [19]. The anatomical confines of the prelacrimal corridor - bounded posteriorly by the NLD, superiorly by the orbital floor, and inferiorly by the alveolar process - require careful dissection. However, meticulous surgical technique and appropriate preoperative radiological assessment may reduce the risk of injury to these structures [8]. Only two patients developed postoperative synechiae, which was associated with the extent of surgical manipulation, emphasising the importance of mucosal preservation and diligent postoperative care.

Healing of the inferior turbinate flap was uniformly satisfactory, with no persistent crusting or granulation tissue observed at the incision site. Preservation and accurate repositioning of this flap may have contributed to the favourable mucosal outcomes and may represent a functional advantage of the PLRA over more destructive alternatives [20].

Early disease persistence/relapse at one month was observed exclusively in patients with CRSwNP. This finding is consistent with the recognised pathophysiology of CRSwNP as a chronic inflammatory condition with a propensity for recurrence despite adequate surgical clearance [21]. As follow-up was limited to one month, this finding more likely reflects early persistence of disease or early treatment failure than true long-term recurrence. While the PLRA may enable effective mechanical removal of disease and restoration of sinus ventilation, long-term disease control in this subgroup remains dependent on sustained postoperative medical therapy and close follow-up.

Overall, the findings of this study suggest that the PLRA may be a feasible technique for selected benign maxillary sinus pathology. Its ability to provide wider access to the maxillary sinus while preserving critical nasal and lacrimal structures may make it useful in cases where access to the anterolateral wall is required [22]. Although inflammatory conditions such as CRSwNP require a multimodal approach, the PLRA may be a useful surgical option within that framework [23]. Emerging literature suggests an expanding role in maxillary sinus surgery and extended endoscopic applications [24].

Limitations

This study has certain limitations. The sample size was small, drawn from a single tertiary care centre using consecutive enrolment rather than a calculated target, which may limit the generalisability of the findings. Follow-up was restricted to one month, in keeping with the study's focus on intraoperative visualisation and early postoperative outcomes, though this cannot capture true long-term recurrence, particularly in CRSwNP, which is prone to delayed relapse; the outcome reported here is therefore early disease persistence/relapse at one month. As this was a descriptive, single-arm feasibility study intended to characterise the technique and its early outcomes, no comparator arm (such as conventional MMA alone) was included, precluding direct comparative conclusions regarding the added benefit of the PLRA. All procedures were performed by a single senior surgeon for the sake of uniformity in surgical technique; while this ensured methodological consistency, it may limit generalisability to surgeons with varying levels of experience. Larger, multicentric, comparative studies with longer follow-up are warranted to validate these findings.

Conclusions

The PLRA can possibly be a good surgical approach for access to the anterolateral aspects of the maxillary sinus, as observed in this feasibility study. In this series, it enabled visualisation of all five walls of the maxillary sinus and clearance of disease, with bidirectional working through both the prelacrimal window and the natural ostium. The approach was associated with low morbidity and minimal complications. Larger comparative studies with longer follow-up are warranted to validate these preliminary findings.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Anubha Mangla, Ravi Meher, Ishwar Singh

Acquisition, analysis, or interpretation of data: Anubha Mangla, Ravi Meher, Nitish Kumar

Drafting of the manuscript: Anubha Mangla, Nitish Kumar

Critical review of the manuscript for important intellectual content: Ravi Meher, Ishwar Singh, Nitish Kumar

Supervision: Ravi Meher, Ishwar Singh

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethics Committee, Maulana Azad Medical College and Associated Hospitals issued approval F.1/IEC/MAMC/MD/MS(108/01/2024/No.106), dated April 3, 2024. **Animal**

subjects: All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Seresirikachorn K, Kondo M, Png LH, Kalish L, Campbell RG, Alvarado R, Harvey RJ: Prelacrimal approach to maxillary sinus pathology. *Am J Rhinol Allergy*. 2023, 37:369-73. [10.1177/19458924221144860](https://doi.org/10.1177/19458924221144860)
2. Lee JJ, Al-Magrihi AZ, Kim D, et al.: Comparison between endoscopic prelacrimal medial maxillectomy and Caldwell-Luc approach for benign maxillary sinus tumors. *Clin Exp Otorhinolaryngol*. 2019, 12:287-93. [10.21053/ceo.2018.01165](https://doi.org/10.21053/ceo.2018.01165)
3. Zhou B, Han DM, Cui SJ, Huang Q, Wang CS: Intranasal endoscopic prelacrimal recess approach to maxillary sinus. *Chin Med J (Engl)*. 2013, 126:1276-80. [10.3760/cma.j.issn.0366-6999.20121754](https://doi.org/10.3760/cma.j.issn.0366-6999.20121754)
4. Im YH, Kim SW, Park CS, Kim DH: The prelacrimal recess approach: a review of surgical applications, outcomes, and recent advances. *J Rhinol*. 2025, 32:17-27. [10.18787/jr.2024.00041](https://doi.org/10.18787/jr.2024.00041)
5. Fokkens WJ, Lund VJ, Hopkins C, et al.: European position paper on rhinosinusitis and nasal polyps 2020. *Rhinology*. 2020, 58:1-464. [10.4193/Rhin20.600](https://doi.org/10.4193/Rhin20.600)
6. Bent JP 3rd, Kuhn FA: Diagnosis of allergic fungal sinusitis. *Otolaryngol Head Neck Surg*. 1994, 111:580-8. [10.1177/019459989411100508](https://doi.org/10.1177/019459989411100508)
7. Huskisson EC: Measurement of pain. *Lancet*. 1974, 304:1127-31. [10.1016/s0140-6736\(74\)90884-8](https://doi.org/10.1016/s0140-6736(74)90884-8)
8. Simmen D, Veerasigamani N, Briner HR, Jones N, Schuknecht B: Anterior maxillary wall and lacrimal duct relationship - CT analysis for prelacrimal access to the maxillary sinus. *Rhinology*. 2017, 55:170-4. [10.4193/Rhin16.318](https://doi.org/10.4193/Rhin16.318)
9. Yu QQ, Guan G, Zhang NK, et al.: Intranasal endoscopic prelacrimal recess approach for maxillary sinus inverted papilloma. *Eur Arch Otorhinolaryngol*. 2018, 275:2297-302. [10.1007/s00405-018-5078-1](https://doi.org/10.1007/s00405-018-5078-1)
10. Lin YT, Lin CF, Yeh TH: Application of the endoscopic prelacrimal recess approach to the maxillary sinus in unilateral maxillary diseases. *Int Forum Allergy Rhinol*. 2018, 8:530-6. [10.1002/alar.22062](https://doi.org/10.1002/alar.22062)
11. Beswick DM, Rodriguez KD, Olds CE, Kass JJ, Schaitkin BM: Quantification of maxillary sinus accessibility via a middle meatal antrostomy. *Am J Rhinol Allergy*. 2015, 29:394-6. [10.2500/ajra.2015.29.4203](https://doi.org/10.2500/ajra.2015.29.4203)
12. Robey A, O'Brien EK, Leopold DA: Assessing current technical limitations in the small-hole endoscopic approach to the maxillary sinus. *Am J Rhinol Allergy*. 2010, 24:396-401. [10.2500/ajra.2010.24.3486](https://doi.org/10.2500/ajra.2010.24.3486)
13. Morrissey DK, Wormald PJ, Psaltis AJ: Prelacrimal approach to the maxillary sinus. *Int Forum Allergy Rhinol*. 2016, 6:214-8. [10.1002/alar.21640](https://doi.org/10.1002/alar.21640)
14. Abdulla M, Refaat O, Alahmer M, Yehia A, Abdelsalam H, Abdelaal K, Shams Eldin M: Prelacrimal recess approach in unilateral maxillary sinus lesions: what is the impact and efficacy?. *Medicina (Kaunas)*. 2024, 60:222. [10.3390/medicina60020222](https://doi.org/10.3390/medicina60020222)
15. Mohankumar V, Kannan DS, Narendrakumar V, Kuppuswamy S, Baby AN: A comparative study between endoscopic prelacrimal approach and middle meatal antrostomy for maxillary sinus pathologies. *Indian J Otolaryngol Head Neck Surg*. 2022, 74:90-5. [10.1007/s12070-021-02703-9](https://doi.org/10.1007/s12070-021-02703-9)
16. Liang N, Qu J, Huang Q, Zhou B: Prelacrimal recess approach for maxillary sinus inverted papilloma: a 15-year experience from a single center. *Eur Arch Otorhinolaryngol*. 2024, 281:4763-71. [10.1007/s00405-024-08551-x](https://doi.org/10.1007/s00405-024-08551-x)
17. Rudmik L, Mace J, Ferguson BJ, Smith TL: Concurrent septoplasty during endoscopic sinus surgery for chronic rhinosinusitis: does it confound outcomes assessment?. *Laryngoscope*. 2011, 121:2679-83. [10.1002/lary.22361](https://doi.org/10.1002/lary.22361)
18. Lin YH, Chen WC: Clinical outcome of endonasal endoscopic prelacrimal approach in managing different maxillary pathologies. *PeerJ*. 2020, 8:e8331. [10.7717/peerj.8331](https://doi.org/10.7717/peerj.8331)

19. Low WK: Complications of the Caldwell-Luc operation and how to avoid them . Aust N Z J Surg. 1995, 65:582-4. [10.1111/j.1445-2197.1995.tb01700.x](https://doi.org/10.1111/j.1445-2197.1995.tb01700.x)
20. Moriyama H, Yanagi K, Ohtori N, Asai K, Fukami M: Healing process of sinus mucosa after endoscopic sinus surgery. Am J Rhinol. 1996, 10:61-6. [10.2500/105065896781795067](https://doi.org/10.2500/105065896781795067)
21. Stevens WW, Schleimer RP, Kern RC: Chronic rhinosinusitis with nasal polyps . J Allergy Clin Immunol Pract. 2016, 4:565-72. [10.1016/j.jaip.2016.04.012](https://doi.org/10.1016/j.jaip.2016.04.012)
22. Kashlan K, Craig J: Dimensions of the medial wall of the prelacrimal recess . Int Forum Allergy Rhinol. 2018, 8:751-5. [10.1002/alr.22090](https://doi.org/10.1002/alr.22090)
23. Orlandi RR, Kingdom TT, Smith TL, et al.: International consensus statement on allergy and rhinology: rhinosinusitis 2021. Int Forum Allergy Rhinol. 2021, 11:213-739. [10.1002/alr.22741](https://doi.org/10.1002/alr.22741)
24. Gao L, Zhou L, Dai Z, Huang X: The endoscopic prelacrimal recess approach to the pterygopalatine fossa and infratemporal fossa. J Craniofac Surg. 2017, 28:1589-93. [10.1097/SCS.00000000000003419](https://doi.org/10.1097/SCS.00000000000003419)