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# Outcomes of endoscopic management of benign maxillary sinus lesions 5-year experience, non-randomized clinical trials

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## Abstract

**Background** When medical therapy fails to control maxillary sinus (MS) disease, surgery is required. There are many advanced MS endoscopic approaches, each one with its anatomical limitations and possible complications. This study aimed to review the outcomes of three endoscopic approaches to the MS (middle meatal antrostomy approach (MMAA), prelacrima recess approach (PLRA), and canine fossa approach (CFA)) to manage benign MS lesions.

**Methods** Sixty-three patients with diseased MS require surgery. Endoscopic MS approaches used include MMAA, PLRA, and CFA. Each approach was used in 21 patients. The outcome of each approach was measured regarding lesion accessibility and clearance, complications (intraoperative or postoperative), and recurrence.

**Results** The maxillary sinus posterior wall was accessible in all approaches. Other walls and different recesses were also accessible in the case of PLRA and CFA with statistically significant difference between the three approaches. There was no significant difference between patients operated by PLRA and CFA regarding accessibility to different walls and recesses of the MS. Endoscopic and radiological recurrence were found in three (15%) patients who were operated by MMAA. There was no evidence of recurrence in patients operated by the other approaches. Complications like crustations, fascial pain, fascial swelling, and fascial hypoesthesia occurred in a few patients.

**Conclusion** By using a suitable endoscopic approach, the different walls and recesses of the MS were completely accessible, so benign MS lesions that required open surgical approaches can be managed endoscopically while preserving the sinus structure and function.

**Keywords** Maxillary sinus, Maxillary sinus endoscopic approaches, Benign maxillary sinus diseases

## Background

Since it was first identified by the ancient Egyptians, the maxillary sinus (MS) has been well studied, particularly in relation to its structure, vasculature, and relationship with the dentition. It is the sinus most affected by disease. It varies markedly in shape, size, position, and

pneumatization, not only in different persons but also in both sides of the same person [1].

A wide spectrum of diseases can affect MS. In simple cases, for visualization and clearance of disease, a standard MMAA may be sufficient, but a drawback still exists in both external and intranasal surgical techniques, and resection of the nasolacrimal duct (NLD) and inferior turbinate (IT) is often unavoidable [2].

There are some areas which cannot be accessed even using multi-angulated telescopes with all types of curved instruments [3, 4]. So, the obligate need for other approaches like CFA, PLRA, and medial maxillectomy approach [5].

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In this study, we review the outcomes of three endoscopic MS approaches MMAA, PLRA, and CFA to manage benign MS lesions.

## Methods

This is a prospective non-randomized clinical study which was conducted in the Otolaryngology Departments of Assiut University Hospitals from October 2017 to October 2022 after obtaining approval from the institutional ethics committee and written informed consent from all patients.

The study included 63 patients who came to Assiut University Hospitals outpatient clinics with radiologically and endoscopically evident MS lesions in the form of de novo or recurrent sinonasal polyposis, antrochoanal polyp, allergic fungal rhinosinusitis, and benign tumors such as inverted papilloma, maxillary sinus cysts, and mucocoele that have no contraindications for surgery.

All patients enrolled in this study were subjected to complete ENT history taking and thorough clinical examination including endoscopic nasal examination with full preoperative laboratory and radiological investigations in the form of computed tomography of the nose and paranasal sinuses (axial and coronal sections)  $\pm$  intravenous contrast  $\pm$  MRI nose and paranasal sinuses axial and coronal cuts. Preoperative biopsy was taken in cases of benign tumors.

Patients were assigned into one of the three approaches based on clinical, endoscopic, and radiological findings

(21 patients underwent MMAA, 21 patients underwent PLRA, and 21 patients underwent CFA).

## Operative technique

It is under endotracheal intubation and hypotensive general anesthesia. The patient lies in the supine position and seated in a horse-hole headrest, and the head of the table was elevated by about 30°. The head was placed in a neutral position. The corneas were protected with an ophthalmic ointment. Decongestion of the nasal mucosa using cotton pledges soaked in 4% lignocaine with 1:10,000 adrenaline.

## Surgical techniques

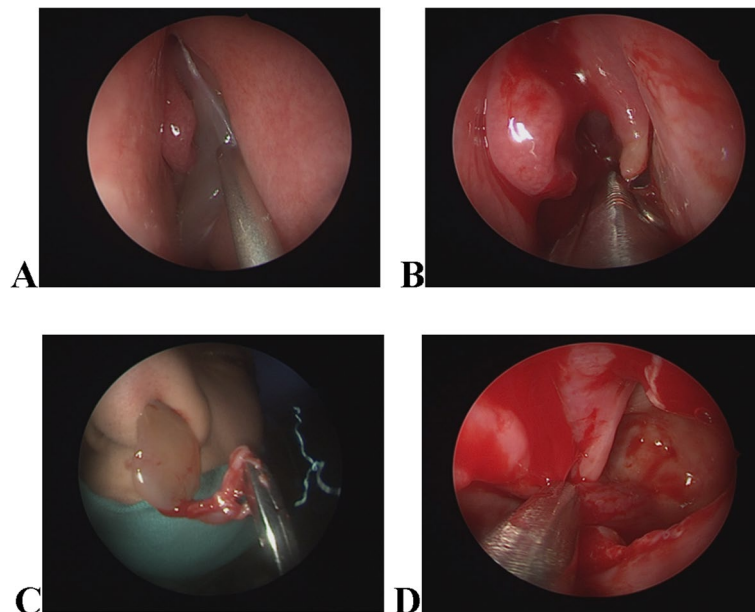
### *The middle meatal antrostomy approach (MMAA) (Fig. 1)*

The middle turbinate was pushed medially, without fracturing the turbinate–skull base junction. The uncinate process becomes in view. Then, uncinectomy was performed (numerous ways). An ostium seeker was passed into the sinus opening and then pushed backward to widen it. Using a through-cutting forceps, the sinus opening was enlarged.

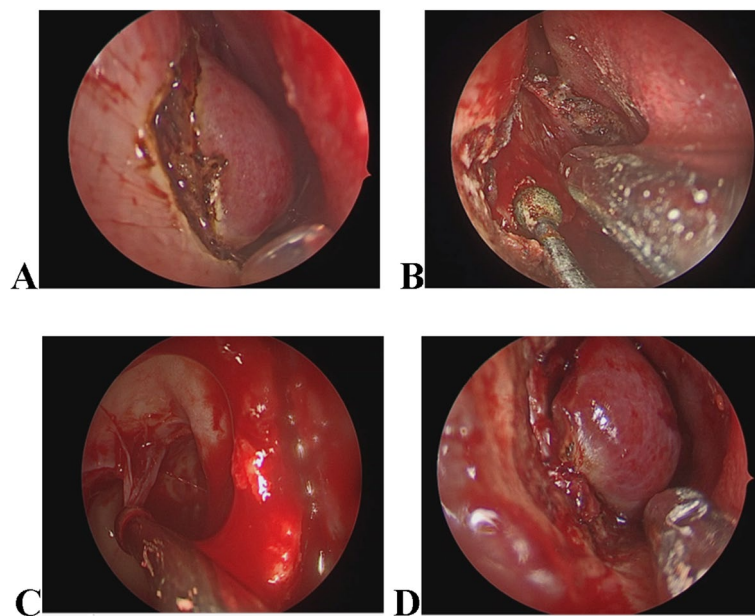
### *The prelacrimal recess approach (PLRA) (Fig. 2)*

A curved incision in the nasal mucosa was made between the anterior end of the inferior turbinate (IT) and the posterior edge of the nasal vestibule and was deepened to reach the underlying bone.

The mucoperiosteum was lifted backward using a chisel until the IT attachment to the lateral nasal wall,



**Fig. 1** Steps of MMAA. **A** Appearance of LT ACP protruding from the middle meatus. **B** Uncinectomy using backbiter and then MMA was performed. **C** Delivery of the polyp transnasally. **D** Removal of the residual polyp at posteroinferior part



**Fig. 2** Surgical steps for PLRA. **A** Mucosal incision of the lateral wall of the nose at the IP anterior margin. **B** Drilling the medial wall of the prelacrimal recess and removal of it using gauche and hammer. **C** Opening in the prelacrimal recess and full exposure of the maxillary sinus and removal of the residual polyp. **D** Repositioning of mucosal flap and closure of the incision

and then this attachment was disconnected. Bone was removed using a gauche and hammer and a high-speed electric drill. By using the IT bony attachment as a landmark, the anterior bony part of the medial wall of the MS was chiseled off, as this part forms the medial wall of the prelacrimal recess.

Backward bone chiseling exposed the nasolacrimal duct (NLD), and then the IT–NLD flap was formed, and it was tucked medially so the medial mucosal wall of the MS will be exposed. Based on the degree of pneumatization or site of the lesion, the anteromedial bony MS wall was partially removed. The prelacrimal recess was opened, and the MS was entered by removing its medial mucosal wall. Then, we check for pathological lesions. Eradication of the whole MS lesion could be done under wide and clear view of a 0° rigid endoscope (Karl Storz Endoscope, Germany) through the opening of the prelacrimal recess.

At the end, the IT–NLD mucosal flap was returned, with no stitches needed; other sinuses were treated according to the underlying diseased status of each patient.

#### The canine fossa approach (CFA)

##### *The transoral approach through a sublabial incision (Fig. 3)*

The landmarks in this approach are a line pass through the mid pupil in the vertical plane and another line running in the horizontal plane along the lower border of nasal ala and lateral aspect of canine fossa high above

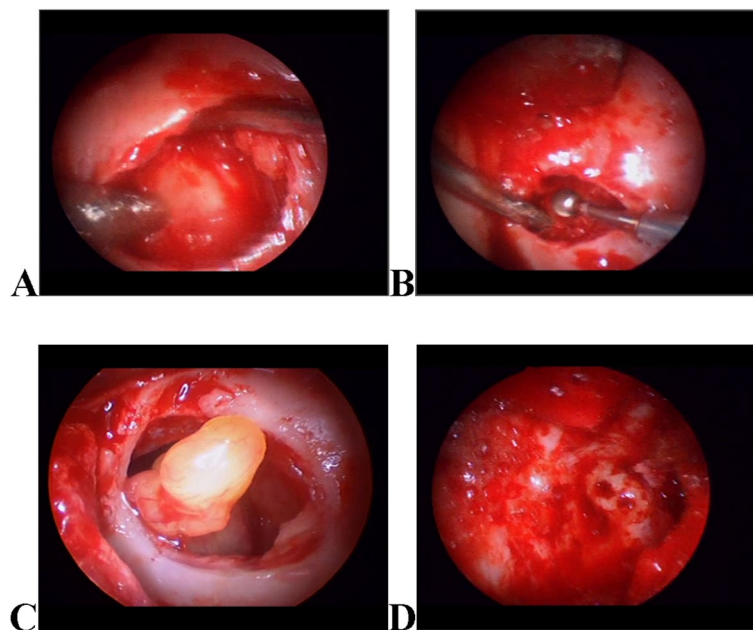
the 3rd and 4th teeth (canine and premolar), inferolateral to infraorbital foramen. The trocar or sometimes a drill should be aimed towards the maxilla ethmoid angle to avoid pterygopalatine fossa and orbital lesions. By a gentle twisting motion, the trocar was inserted. In thicker bones, gentle tapping with a hammer was required, or we can use burr. After removal of the trocar, a 4-mm microdebrider blade was inserted through the passage created. The microdebrider blade was visualized in the MS with a 40 or 70° endoscope via the MMA. The diseased tissue was removed from the MS using the microdebrider.

#### Follow-up

Follow-up visits every week during the first month. Then, the follow-up was monthly for over 5 months, and then last follow-up visit was done at the end of the 12th month.

#### Each patient was subjected to the following:

- Endoscopic follow-up:** The first office visit was scheduled after a week following the surgery. After application of topical anesthesia (lidocaine 10%), any blood clots or crustations at site of incision were endoscopically removed, and any synechiae were released.
- Symptomatic:** The patient was asked for facial pain using VAS score, facial hypoesthesia, facial swelling, and epiphora.



**Fig. 3** Surgical steps of CFA. **A** Wide sublabial incision corresponding to canine fossa and dissection of the periosteum to make good exposure. **B** Penetrating the thin bone of the fossa using diamond burr and widening of the opening. **C** Residual part on the lateral wall which was removed by using shaver. **D** Complete removal of the polyp

**C. Radiological:** In the form of MSCT nose and paranasal sinuses at the end of the 6th month

*The outcome of each approach was measured regarding lesion accessibility and clearance, intraoperative or postoperative complications, and postoperative recurrence.*

### Statistical analysis

Collection and analysis of the data by using SPSS (Statistical Package for the Social Science, version 20, IBM, and Armonk, New York). Quantitative data was expressed as mean  $\pm$  standard deviation (SD) and compared with ANOVA. Nominal data were given as number (n) and percentage (%). *Chi-square* test was implemented on such data. Level of confidence was kept at 95%, and hence, *p*-value was considered significant if  $< 0.05$ .

### Results

Mean age of MMAA patients was  $28.60 \pm 8.04$  years, and majority 13 (60%) of patients in this group were males, and 8 (40%) patients were females. Mean age of PLRA patients was  $33.45 \pm 13.81$  years, and majority (60%) of patients in this group was males, and 8 (40%) patients were females. Mean age of CFA patients was  $33.40 \pm 13.52$  years, and majority (70%) of patients in this group was males, and 6 (30%) patients were females.

It was found that the three studied approaches showed no significant difference as regard age ( $p = 0.35$ ) and sex ( $p = 0.75$ ) (Table 1).

The 63 cases were antrochoanal polyp (ACP) (36.70%), inverted papilloma (IP) (30%), and allergic fungal rhinosinusitis (AFR) (18.30%). Four patients had bilateral nasal polyps (6.7%). Two patients had fungal balls (3.33%). Each chronic invasive fungal rhinosinusitis (CIFR), maxillary osteoma, and maxillary pyocele were present in only one patient (Table 2).

The posterior wall was accessible in all approaches. Other walls and different recesses were also accessible in the case of PLRA and CFA.

The anterior wall, medial wall, and prelacrimal recess were not accessible by the MMAA. In only 6 (30%), 5 (25%), 2 (10%), 2 (10%), and 1 (5%) patient who underwent that approach, lateral wall, superior wall, inferior wall, zygomatic recess, and alveolar recess, respectively, were accessible (Table 3 and Fig. 4).

**Table 1** Age and sex among studied approaches

	MMAA (n = 21)	PLRA (n = 21)	CFA (n = 21)	p-value
Age (years)	$28.60 \pm 8.04$	$33.45 \pm 13.81$	$33.40 \pm 13.52$	0.35
Sex				0.75
Male	13 (60%)	13 (60%)	15 (70%)	
Female	8 (40%)	8 (40%)	6 (30%)	



**Table 2** Diagnosis of the studied patients

	N=60
ACP	24 (36.70%)
IP	19 (30%)
AFR	11 (18.30%)
Bilateral nasal polyps	4 (6.7%)
Fungal ball	2 (3.33%)
CIFR	1 (1.7%)
Maxillary osteoma	1 (1.7%)
Maxillary pyocele	1 (1.7%)

**Table 3** Lesion accessibility of different approaches in the current study

	Approaches			p-value
	MMAA (n=21)	PLRA (n=21)	CFA (n=21)	
Posterior wall	21 (100%)	21 (100%)	21 (100%)	0.36
Anterior wall	0	21 (100%)	21 (100%)	<0.001
Medial wall	0	21 (100%)	21 (100%)	<0.001
Lateral wall	6 (30%)	21 (100%)	21 (100%)	<0.001
Superior wall	5 (25%)	21 (100%)	21 (100%)	<0.001
Inferior wall	2 (10%)	21 (100%)	21 (100%)	<0.001
Zygomatic recess	2 (10%)	21 (100%)	21 (100%)	<0.001
Para-lacrimal recess	0	21 (100%)	21 (100%)	<0.001
Alveolar recess	1 (5%)	21 (100%)	21 (100%)	<0.001

None of those patients who underwent MMAA developed any complications, while only two patients from those who underwent PLRA suffered crust formation at the site of incision.

It was found that 3 (15%), 4 (20%), and 2 (10%) patients from those underwent CFA developed facial pain, facial hypoesthesia, and facial swelling, respectively (Table 4).

Endoscopic and radiological recurrence were found in three (15%) patients who underwent MMAA. No radiological or endoscopic evidence of recurrence was reported in patients who underwent other approaches (Table 5).

## Discussion

A wide variety of lesions can affect the maxillary sinus, such as inflammatory, odontogenic, and neoplastic. Since maxillary antrostomy was introduced in the 1980s, endoscopic sinus surgery of the MS has significant advances in technique and approaches [6].

The maxillary sinus is the largest and perhaps the most operated sinus in endoscopic surgery of the

sinuses. In simple cases, for visualization and disease clearance, a standard MMAA may be sufficient, but a drawback still exists in both external and intranasal surgical techniques, and resection of the nasolacrimal duct (NLD) and inferior turbinate (IT) is often unavoidable [2].

Despite the advances in instrumentation in sinus surgery, some anatomical areas of this sinus still represent a technical challenge for the sinus surgeon due to difficulty accessing them by traditional techniques. The anterior and anteromedial areas of the MS represent examples of these sites. Many procedures have been used to access lesions of the ventral part of the MS, and each has its own limitations and drawbacks [7].

Zhou et al. [2] described an alternative approach to the MS and named it the PLRA. This involves endoscopic removal of the part of medial maxillary wall ventral to the NLD. As a result, the anterior part of the MS is opened without sacrificing the NLD or the inferior turbinate. Accordingly, most of the complications of the other techniques are avoided.

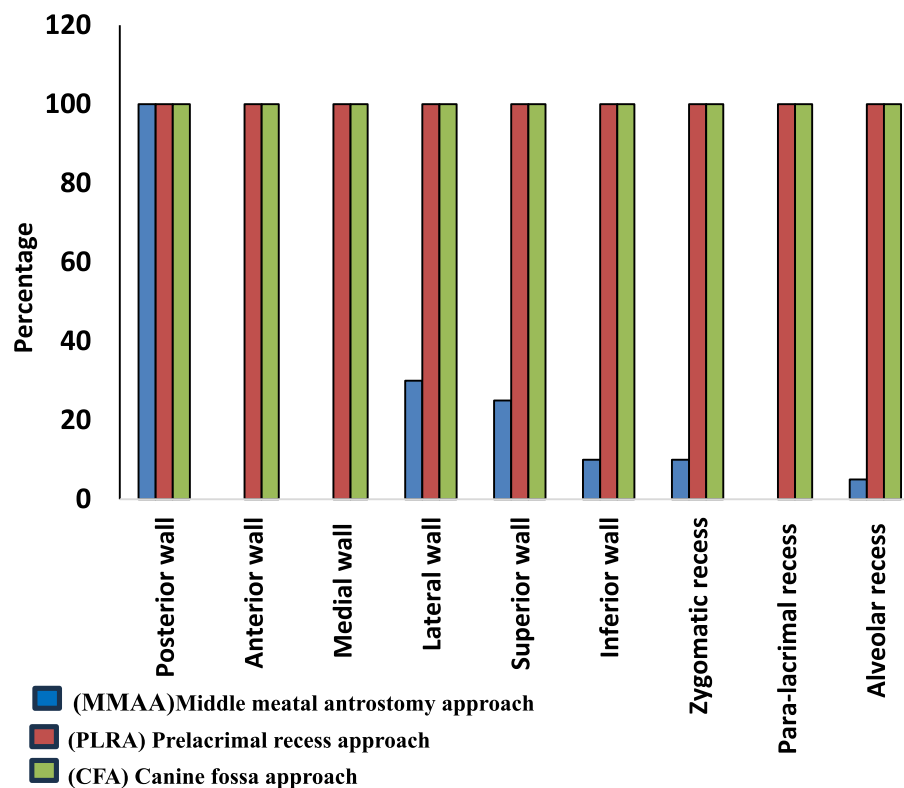
Canine fossa approach (CFA) has been used as an alternative technique for accessing the MS. The efficacy and value of this approach compared with conventional MMAA require further research [6].

In this study, it was found that the patients managed by the three approaches showed no significant difference regarding age ( $p=0.35$ ) and sex ( $p=0.75$ ). Regarding lesion accessibility, all the three approaches gain accessibility to the posterior wall. All other walls and different recesses were also accessible in the case of PLRA and CFA. Anterior wall, medial wall, and prelacrimal recess were not accessible by the MMAA. In only 6 (30%), 5 (25%), 2 (10%), 2 (10%), and 1 (5%) patients who underwent that approach, lateral wall, superior wall, inferior wall, zygomatic recess, and alveolar recess, respectively, were accessible.

Zhou et al. [2] stated that by using the PLRA, all recesses of the MS should be easily reachable under a 0° rigid nasal endoscope. This agrees with our study in that the 0° endoscope could be used successfully in most parts of the operation.

Postoperative complications noticed among the three approaches are typically few, and usually not hazardous. None of those patients who underwent MMAA developed any complications. While only four patients from those underwent both PLRA and CFA, two in each group suffered crustation at the site of incision. Following up of those patients and removal of the crustations and local lubricant use, the crustations disappeared at the end of the first month.

Our results do not agree with a study done by Comoglu et al. [8] which was done on 12 patients operated



**Fig. 4** Lesion accessibility of different approaches in the current study

**Table 4** Postoperative complications

	MMAA (n=21)	PLRA (n=21)	CFA (n=21)	p-value
Facial pain	0	0	3 (15%)	0.04
Facial hypoesthesia	0	0	4 (20%)	0.01
Epiphora	0	0	0	—
Synechia	0	0	0	—
Crustation	0	2 (10%)	0	0.12
Facial swelling	0	0	2 (10%)	0.12

**Table 5** Postoperative radiological and endoscopic recurrence

Recurrence	MMAA (n=21)	PLRA (n=21)	CFA (n=21)	p-value
Radiologically	3 (15%)	0	0	0.04
Endoscopically	3 (15%)	0	0	0.04

by PLRA and reported that 3 (25%, 3/12) patients had synechiae.

In our study, 20% of the patients operated by CFA had facial pain and hypoesthesia in the cheek and upper lip

area, and by the end of the third month follow-up visit, only one (7.1%) patient had a facial pain.

Our results agree with the study by Byun and Lee [9] who reported that although many complications occurred with CFA (e.g., facial pain, numbness, and cheek swelling), these symptoms resolved spontaneously within 3 months.

Also, our results agree with the study by Tran et al. who reported one case in their series with temporary hypoesthesia of the upper lip and the face adjacent to the inferior aspect of the pyriform aperture which resolved after 6 weeks [10].

The neurologic complications are due to trauma to the infraorbital nerve branches, principally the anterior superior alveolar nerve and less commonly the middle superior alveolar nerve [11]. In CFA, the trauma of the infraorbital nerve is more liable and severe during creation of the antral window while elevation of the periosteum. In PLRA, the nerve damage is transient and minimal due to thermal injury by cauterization.

In our study, cheek swelling was reported in two patients in the CFA group during the first week post-operatively but resolved by the end of the first month. Our results agree with a study of 40 patients operated

by CFA done by Robinson and Wormald [10], which reported cheek swelling in 14 (38%) patients.

Bernal-Sprekelson et al. showed that in 30% of cases operated by CFA, anesthesia was present for up to 2 weeks and persisted long term in 6%. Paresthesia persisted in 3% of cases. Facial pain lasted up to 4 weeks in 25% of cases but only persisted in 2% of cases. Most discomforts ceased after 2–8 weeks [12].

Whittet et al. reported a range of complications from sneezing (9%) and gum numbness (26%) to cheek pain (61%) and swelling (78%) [12]. However, none of their patients had persistent complications.

In our study, none of the patients managed by the three approaches reported occurrence of epiphora. Zhou et al. [2] reported NLD injury in two patients during endoscopic removal of schwannoma of the pterygopalatine and infratemporal fossae via the PLRA, but neither had epiphora postoperatively, which agree with our results.

In this study, endoscopic and radiological recurrence were found in three (15%) patients who underwent MMAA; two of them had AFR, and the third one had ACP. None of those who underwent other approaches developed either radiological or endoscopic recurrence.

For many MS diseases, the use of PLRA and CFA is useful with excellent access and exposure to all walls and recesses without lacrimal duct or inferior turbinate injury and less recurrence [13].

Ismael and Abdelazim [14] stated that there are no recurrence during the follow-up period in patients operated by the prelacrimal recess approach, which is in agreement with our study.

## Conclusion

A wide range of advanced endoscopic access ways to the MS exist, and each has its anatomical limitations and possible complications. With the use of a suitable endoscopic approach, the different walls and recesses of the MS were completely accessible, so benign MS lesions can be managed endoscopically without injuring the sinus mucosa or disrupting normal mucociliary clearance, so preserving the sinus structure and function.

## Abbreviations

MS	Maxillary sinus
MMA	Middle meatal antrostomy
MMAA	Middle meatal antrostomy approach
PLRA	Prelacrimal recess approach
CFA	Canine fossa approach
NLD	Nasolacrimal duct
IT	Inferior turbinate
MRI	Magnetic resonance imaging
MSCT	Multislice computed tomography
Fig.	Figure.
SPSS	Statistical Package for the Social Science
SD	Standard deviation
ACP	Antrochoanal polyp

IP	Inverted papilloma
AFR	Allergic fungal rhinosinusitis
CIFR	Chronic invasive fungal rhinosinusitis

## Acknowledgements

Not applicable

## Authors' contributions

MO selected the research idea, did the endoscopic sinus surgery for the patients, and was a major contributor in writing the manuscript. AI helped in doing the practical research work and was a major contributor in writing the manuscript. AA revised and analyzed the data. SI helped by preparing the patients for surgery and collected and analyzed the patient's data. All authors read and approved the final manuscript.

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## Availability of data and materials

The data and materials are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

Ethics approval by the Institutional Review Board of the Faculty of Medicine Assiut University NO (17200344). Consent to participate: Written informed consent from all patients.

### Consent for publication

Written consent for publication was signed by all patients.

### Competing interests

The authors declare that they have no competing interests.

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