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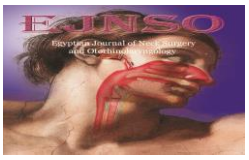

Endoscopic approaches to the maxillary sinus: A comparative study

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Abstract:

Background: Treatment of inflammatory and neoplastic diseases of maxillary sinus requires appropriate surgical exposure. Despite the use of multi-angulated endoscopes and curved instruments, there are some areas which still cannot be handled or viewed. So, further approaches other than the standard technique are needed to improve visualization and access to make possible disease control.

Aim: To compare the outcomes of middle meatal antrostomy approach (group A), endoscopic prelacrimal recess approach (group B) and canine fossa approach (group C).

Patients and methods: Sixty patients with maxillary sinus lesions justifying surgery were included in this study. Patients were classified into 3 groups A, B and C, each one included 20 patients and were subjected to middle meatal antrostomy approach, endoscopic prelacrimal recess approach, and canine fossa approach respectively. Comparison between groups was done regarding ability of each approach to access, visualize and reach different recesses and walls of the maxillary sinus, postoperative or intraoperative complications and postoperative recurrence.

Results: There was no significant difference found between group B and C regarding complete accessibility to different recesses and walls of the maxillary sinus. Only three (15%) patients from those who underwent middle meatal antrostomy approach had radiological and endoscopic recurrence, on the other hand none of those who underwent other approaches developed recurrence. Complications occurred in our study were quite few and not dangerous .

Conclusion: Prelacrimal recess approach and canine fossa approach are useful methods for diverse maxillary sinus lesions with excellent accessibility to all walls and recesses without lacrimal duct or inferior turbinate injury and less recurrence.

Key words: Maxillary sinus, endoscopic approaches, middle meatal antrostomy approach, prelacrimal recess approach, canine fossa approach.

Introduction

The maxillary sinus is the most common sinus affected by disease. It varies greatly in shape, position, size, and pneumatization, not only individuals, but also in both sides of the same individual. [1]

A wide variety of diseases can involve the maxillary sinus. A standard uncinectomy and middle meatal

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antrostomy may be sufficient for clearance of disease and visualization in simple cases, but despite this, a disadvantage still exists in both intranasal and external surgical procedures, compromise of the nasolacrimal duct (NLD) and inferior turbinate (IT) is often unavoidable. [2]

Despite use of multi-angulated endoscopes and curved instruments, there are some areas which still cannot be handled or viewed. [3, 4] As a result other approaches are needed like prelacrimal recess approach (PLRA), canine fossa approach (CFA) and medial maxillectomy approach. [5]

Review of the available literature revealed no evidence based medicine or meta-analysis comparing different endoscopic approaches to maxillary sinus regarding accessibility to different recesses and residual lesions.

Patients and methods:

This is a prospective comparative randomized clinical study which was conducted in the Otolaryngology departments of both Assiut and Alexandria University Hospitals from October 2019 to October 2021 and was approved by the Local Committee of Ethics, Faculty of Medicine, Assiut university (IRB no: 17200344).

The study included 60 patients who came to both Assiut and Alexandria University Hospitals outpatient clinics aged > 18 years with radiologically and endoscopically evident maxillary sinus lesions in the form of denovo or recurrent sinonasal polyposis, antrochoanal polyp, allergic fungal rhinosinusitis, benign tumors like inverted papilloma, sinonasal malignant tumours extending to the maxillary sinus, maxillary sinus cysts and mucocele that having no contraindications for surgery.

Patients aged < 18 years, had previous open approach to maxillary sinus, radiological evidence of non pneumatized prelacrimal recess and having contraindications for surgery were excluded from the study.

Full ENT history taking, thorough clinical examination including endoscopic endonasal examination using a 0°, 2.7 mm rigid telescope (Karl Storz_Endoskope, Germany) and full preoperative laboratory and radiological investigations in the form of coronal and axial computed tomography of the nose and paranasal sinuses ± intravenous contrast ± MRI nose and paranasal sinuses coronal and axial cuts were done for all patients. Fig. (1).

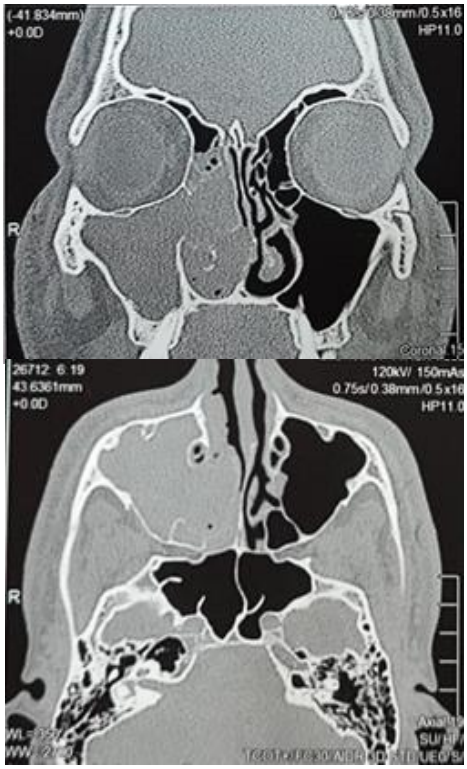

Fig. (1): Right Antrochoanal Polyp (ACP) with type III prelacrimal recess.

Randomly patients were assigned into three equal groups .

Patients of (Group A) underwent middle meatal antrostomy approach (n=20), patients of (Group B) underwent endoscopic prelacrimal recess approach

(n=20) and patients of (Group C) underwent canine fossa approach (n=20).

Sample randomization was used using a computer-generated random numbers in a table to assign the patients in 1:1:1 ratio to the treatment groups A, B and C .

After taking a written consent before participation to the study at the time of enrolment, patients were randomly assigned in numeric order to the corresponding treatment group. Randomization was done online to generate the randomization list (https://www.sealedenvelope.com https://www.sealedenvelope.com/simple randomizer/v1/lists)

Operative technique:

Under hypotensive general anesthesia and endotracheal intubation, the patient in supine position on the operating table, seated in a horse-hole headrest. The head of the table was elevated by about 30 degrees. The head was placed in a neutral position. The corneas were protected with an ophthalmic ointment. Decongestion of the nasal cavities was done using pledges of cotton soaked in 4% lignocaine with 1:10,000 adrenalines.

Surgical techniques:

I. Group A, **middle meatal antrostomy approach (MMA)** Fig. (2):

Under guidance of endoscope, a 0°, 2.7 mm rigid telescope (Karl Storz_Endoskope, Germany), the middle turbinate was moved medially gently to avoid fracturing the turbinate–skull base junction. Then, the uncinate process should be viewed at this point. Uncinectomy was the next step which was performed in many ways. Once identification of the natural ostium was done, an ostium seeker was inserted through the ostium and was pushed posteriorly to widen the ostium. Using a through-cutting forceps, enlargement of the ostium was done.

II. Group B, **Prelacrimal recess approach (PLRA)** Fig. (3):

A mucosal incision was done on the lateral wall of the nasal cavity between the the posterior end of the nasal vestibule and the anterior part of the inferior turbinate (IT) and, the depth of the incision reached the underlying bone.

The mucoperiosteum was lifted posteriorly using a chisel until the attachment of IT to the lateral nasal wall. After that the bony attachment of IT was disconnected. Bone was removed using a high-speed electric drill or gauche and hammer and extra bone removal was done using kerrison rongeurs. The bony attachment of the IT used as a landmark, the anterior portion of the bony part of the medial wall of the MS was chiseled off, as it forms the medial part of the prelacrimal recess.

Posterior chiseling of bone exposed the nasolacrimal duct (NLD) and the IT–NLD flap was elevated, pushing the flap medially exposed the medial mucosal wall of the MS. Partial removal of the anteromedial bony wall of the MS was done according to the location of the lesion and extension of sinus pneumatization. Under clear and wide view of a 0°, 2.7 mm rigid telescope (Karl Storz_Endoskope, Germany) inserted from the opening of the prelacrimal recess the MS was entered and pathological lesions were removed.

Repositioning of the IT–NLD mucosal flap was done at the end of the operation and no stitches were needed.

III. Group C, **The canine fossa approach (CFA):** which was done either Transnasally or Transorally:

The Trans oral approach using a sublabial incision Fig. (4):

Canine approach landmarks are: first line is an horizontal line running along

the lower border of nasal ala and lateral aspect of canine fossa above the canine and premolar teeth, inferolateral to infraorbital foramen and the second line is the mid pupillary line. A trocar or sometimes a drill should be applied towards the maxillo ethmoidal angle avoiding orbital and pterygopalatine fossa contents. The trocar was applied in most patients using a gentle twisting motion. Some times when bone is thick, the trocar was inserted using either gentle tapping with a hammer or a drill. A 4-mm microdebrider blade (Karl Storz unidrive S III ENT, Germany) used for removal of polyps and diseased tissue was inserted through the passage created and it was visualized in the maxillary sinus with a 45° or 70°, 2.7 mm rigid telescope (Karl Storz_Endoskope, Germany) via the middle meatal antrostomy.

The transnasal approach Fig. (5)

A mucosal incision was done on the lateral wall of the nasal cavity between the the posterior end of the nasal vestibule and the anterior part of the inferior turbinate (IT) and, the depth of the incision reached the underlying bone.

Then elevation of the mucosa of the lateral nasal wall posteriorly and periosteum dissection of the anterior maxillary wall & canine fossa anteriorly was done. Identification of the anterior superior alveolar nerve was done and we tried to preserve it. The thin bone of the canine fossa was penetrated using diamond burr making a passage through which a 4-mm microdebrider blade (Karl Storz unidrive S III ENT, Germany) or any instrument was inserted together with a 0°, 2.7 mm rigid telescope (Karl Storz_Endoskope, Germany) where diseased tissue was removed from the maxillary sinus.

Comparison between the three groups was done regarding the following points:

1. Assessment of each approach accessibility to reach and visualize the different recesses and walls of the maxillary sinus.
2. Intraoperative and postoperative complications.
3. Postoperative residue or recurrence detected by endoscopic examination or by MSCT scan.

Follow up:

During the first month, follow-up visits were weekly. Then the follow up was monthly for over 3 months then last follow up visit was done at the end of the sixth month.

Each patient was subjected to the following:

A. Endoscopic follow up: The first visit was after a week following the surgery. After topical anesthesia (lidocaine 10%) application, any crustations at site of incision or blood clots were endoscopically removed and any synechiae were released .
B. Symptomatic: The patient was asked for facial pain using VAS score, facial hypothesia, facial swelling and epiphora.
C. Radiological: In the form of MSCT nose and paranasal sinuses at the end of the sixth month.

Statistical analysis

Using SPSS (Statistical Package for the Social Science, version 20, IBM, and Armonk, New York), data was collected and analyzed.

Expression of quantitative data was done as mean ± standard deviation (SD) and compared with ANOVA. Nominal data were given as number (n) and percentage (%).

Chi2 test was implemented on such data. Confidence level was kept at 95% and hence, P value was considered significant if < 0.05

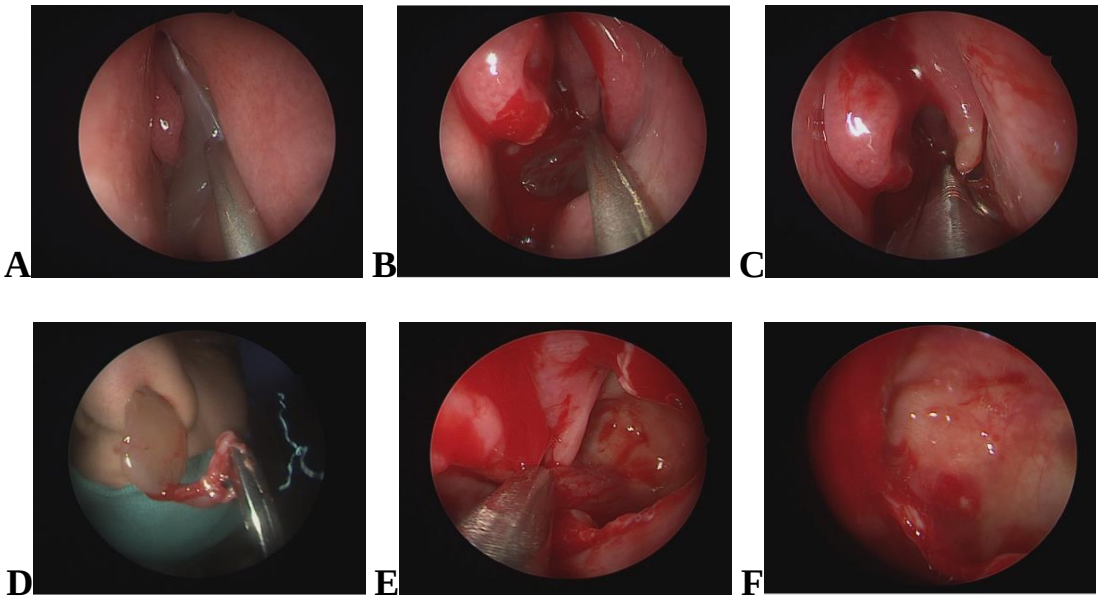

Fig. (2): Steps of middle meatal antrostomy (MMA): (A&B) Appearance of LT ACP protruding from the middle meatus (C) Uncinectomy using backbiter & then MMA was performed (D) Delivery of the polyp trans nasally (E) Removal of the residual polyp at postero inferior part (F) Clearance of the maxillary sinus.

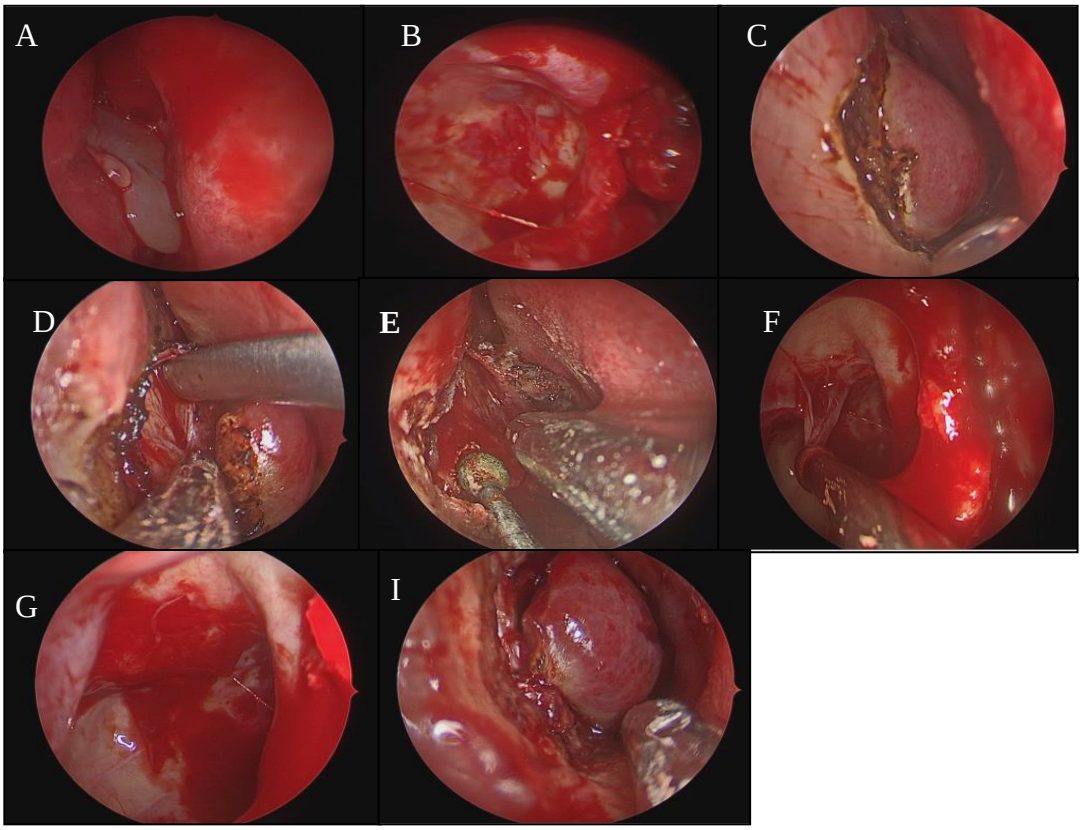

Fig. (3): Prelacrimal recess approach steps: (A) RT ACP protruding from the middle meatus. (B) Residual part of the polyp seen at anterolateral part of the maxillary sinus after uncinectomy, MMA& removal of the polyp. (C) Mucosal incision of the anterior margin of the inferior turbinate. (D) Posterior elevation of the lateral nasal wall mucosa and periosteum dissection. (E) Drilling the prelacrimal recess medial wall & its removal. (F&G), Full maxillary sinus exposure and removal of the residual polyp. (L) Repositioning of mucosal flap.

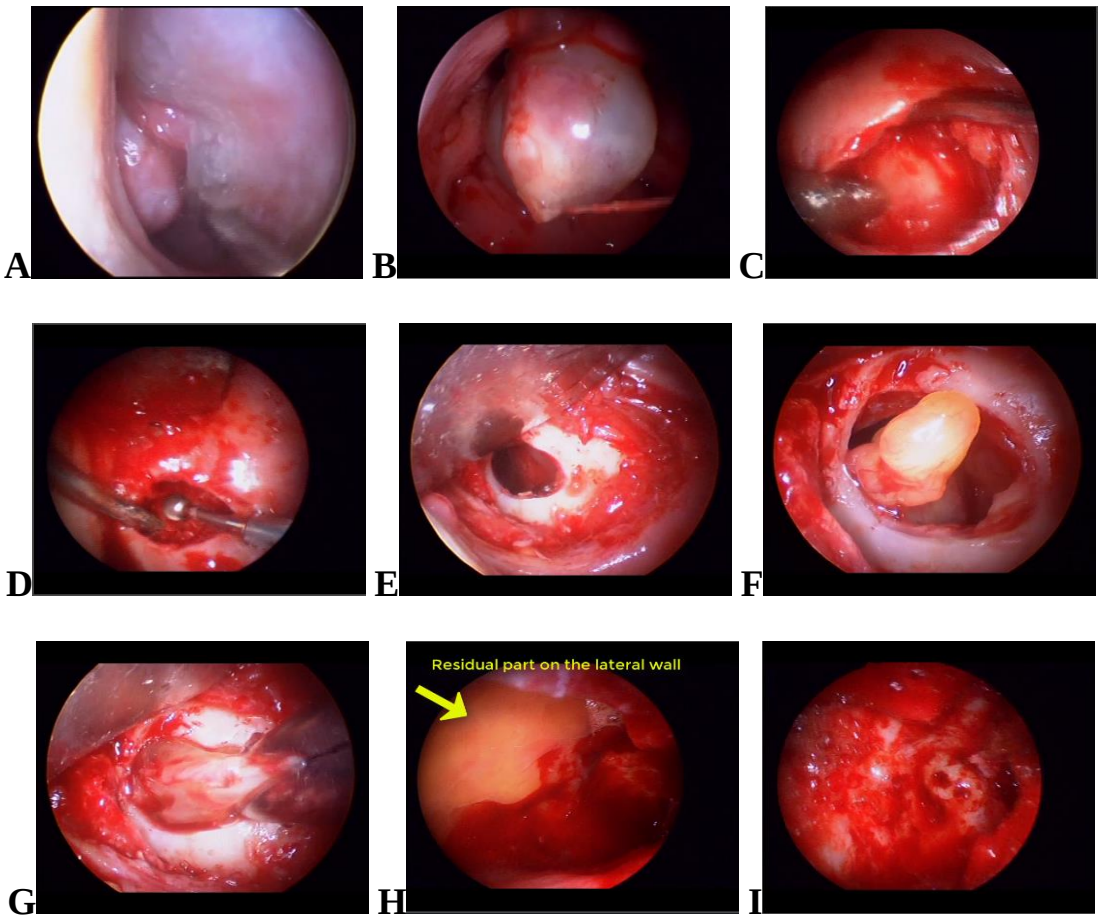

Figure (4): (A& B) Appearance of RT ACP both transnasal & transoral respectively. (C) Wide sublabial incision corresponding to canine fossa & dissection of the Periosteum to make good exposure (D&E) the thin bone of the fossa was removed using diamond burr and widening of the opening. (F&G) Appearance of residual polyp through the opening and its removal using straight Blakesly forceps. (H) Residual part on the lateral wall which was removed by using shaver. (I) Complete polyp removal.

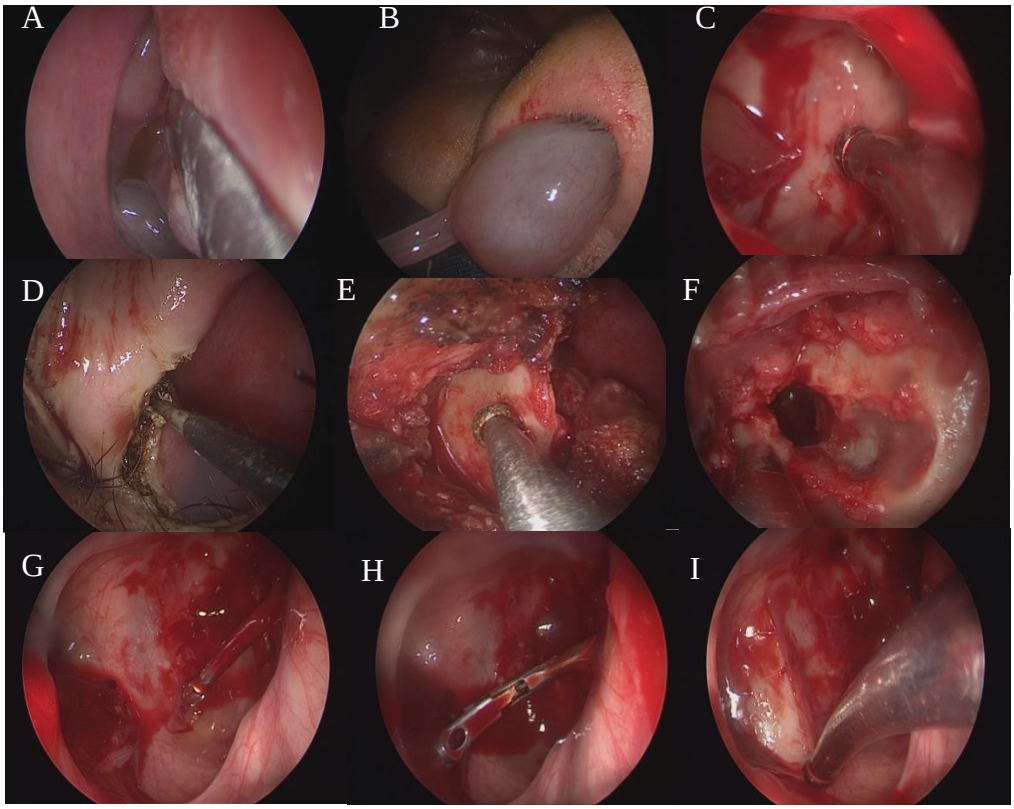

Fig. (5): Trans nasal CFA steps: (A) RT ACP protruding from the middle meatus. (B) delivery of the polyp trans nasally. (C) Uncinectomy, MMA& residual part of the polyp seen at anterolateral part of the maxillary sinus (D) Mucosal incision of the anterior margin of the inferior turbinate. (E&F) Penetrating the thin bone of the fossa using diamond burr and make an opening about 4 mm. (G&H) The residual part seen through the opening using 0 degree endoscope and removing it using the instrument from the middle meatus. (I) Full exposure of the cleaned maxillary sinus.

Results

Mean age of group A was 28.60 ± 8.04 years and majority (60%) of patients in this group was males and 8 (40%) patients were females. Mean age of group B was 33.45 ± 13.81 years and majority (60%) of patients in this group was males and 8 (40%) patients were females. Mean age of group C was 33.40 ± 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 groups showed no statistically significant difference as regard age (p= 0.35) and sex (p= 0.75), Table (1).

The cases were antrochoanal polyp (36.70%), inverted papilloma (30%) and allergic fungal rhinosinusitis (18.30%). Three patients had bilateral nasal polyps. Two patients had fungal ball (3.33%). Each of chronic invasive fungal rhinosinusitis (CIFR), maxillary osteoma, maxillary osteosarcoma and maxillary pyocele were present in only one patient, Table (2).

The posterior wall was accessible in all approaches with no statistically significant difference between the three groups. Other walls and different recesses were also accessible in case of endoscopic prelacrimal recess and canine fossa approaches which shows statistically significant difference between groups B,C and A .

The anterior wall, medial wall and prelacrimal recess were not accessible by the middle meatal antrostomy approach. 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, which shows statistically significant difference between the three groups Table (3) & Fig. (6).

None of those patients who underwent middle meatal antrostomy approach developed any complications while only two patients from those underwent endoscopic prelacrimal recess approach suffered crust formation at site of incision .

It was found that 3 (15%), 4 (20%), 2 (10%), 1 (5%) and 2 (10%) patients from those underwent canine fossa approach developed facial pain, facial hypothesia, crustation at site of incision, synechiae and facial swelling, respectively, Table (4).

There is statistically significant difference between groups regarding facial pain and facial hypothesia, on the other hand no statistically significant difference between groups regarding crustations at site of incision, synechiae and facial swelling.

Only three (15%) patients from those who underwent middle meatal antrostomy approach had radiological and endoscopic recurrence which is statistically significant. None of those who underwent other approaches developed either radiological or endoscopic recurrence, Table (5).

Table (3): Accessibility of different approaches in the current study:

	Groups			*P* value
	A (n= 20)	B (n= 20)	C (n= 20)	
Posterior wall	20 (100%)	20 (100%)	20 (100%)	0.36
Anterior wall	0	20 (100%)	20 (100%)	< 0.001
Medial wall	0	20 (100%)	20 (100%)	< 0.001
Lateral wall	6 (30%)	20 (100%)	20 (100%)	< 0.001
Superior wall	5 (25%)	20 (100%)	20 (100%)	< 0.001
Inferior wall	2 (10%)	20 (100%)	20 (100%)	< 0.001
Zygomatic recess	2 (10%)	20 (100%)	20 (100%)	< 0.001
Para-lacrimal recess	0	20 (100%)	20 (100%)	< 0.001
Alveolar recess	1 (5%)	20 (100%)	20 (100%)	< 0.001

Table (4): Postoperative complications in different groups

	Group A (n= 20)	Group B (n= 20)	Group C (n= 20)	P value
Facial pain	0	0	3 (15%)	0.04
Facial hypothesia	0	0	4 (20%)	0.01
Epiphora	0	0	0	---
Crustation	0	2 (10%)	2 (10%)	0.34
Synechiae	0	0	1 (5%)	0.36
Facial swelling	0	0	2 (10%)	0.12

Table (5): Postoperative radiological and endoscopic recurrence in different groups:

Recurrence	Group A (n= 20)	Group B (n= 20)	Group C (n= 20)	*P* value
Radiologically	3 (15%)	0	0	0.04
Endoscopically	3 (15%)	0	0	0.04

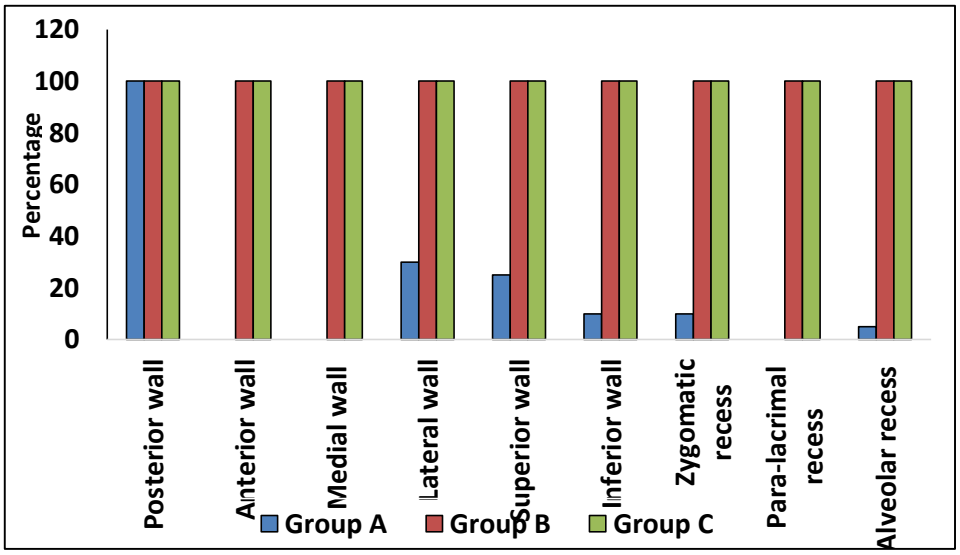

Figure (6): Accessibility of different approaches in the current study

Discussion :

The maxillary sinus is the largest and perhaps the most commonly operated sinus in ESS. Despite the advances in instrumentation in sinus surgery, some anatomical sites of this sinus still represent a technical challenge for the sinus surgeon due to difficulty accessing them by traditional techniques. The anteromedial and anterior areas of the maxillary sinus represent examples of these sites.

A wide variety of diseases can involve the maxillary sinus. A standard uncinectomy and middle meatal antrostomy may be sufficient for clearance of disease and visualization in simple cases, but despite this, a disadvantage still exists in both intranasal and external surgical procedures, compromise of the nasolacrimal duct (NLD) and inferior turbinate (IT) is often unavoidable.[2]

Many techniques have been used to access anterior maxillary sinus lesions and each has its own limitations and drawbacks.

Zhou et al [2] described an alternative maxillary sinus approach, named it the prelacrimal recess approach. This involves endoscopic removal of the medial maxillary wall anterior to the NLD. As a result, the anterior maxillary sinus 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 regarded as a method of obtaining access to the maxillary antrum. A few studies have demonstrated the benefits of CFA in management of the severely diseased maxillary sinus and so, comparison of the superiority and efficacy of this method with conventional MMA is required.[6]

Review of the available literature revealed no evidence based medicine or meta-analysis comparing different endoscopic approaches to maxillary sinus regarding accessibility to different recesses and residual lesions.

So in this study we compared between three of these approaches which are middle meatal antrostomy approach, endoscopic prelacrimal recess approach and canine fossa approach.

This study included 60 patients who had been divided into three equal groups; group A (middle meatal

antrostomy approach), group B (endoscopic prelacrimal recess approach) & group C (canine fossa approach), each one included 20 patients.

The mean age of group A was 28.60 ± 8.04 years and the majority (60%) of patients in this group was males and (40%) were females. Mean age of group B was 33.45 ± 13.81 years and the majority (60%) of patients in this group was males and (40%) were females. Mean age of group C was 33.40 ± 13.52 years and majority (70%) of patients in this group was males and (30%) were females, (Table 1).

It was found that the three studied groups showed no significant difference regarding age (p= 0.35) and sex (p= 0.75).

The most frequent diagnoses of the studied patients were antrochoanal polyp (36.70%), inverted papilloma (30%) and allergic fungal rhinosinusitis (18.30%). Three patients had bilateral nasal polyps. Two patients had fungal ball. Each of chronic invasive fungal rhinosinusitis, maxillary osteoma, maxillary osteosarcoma and maxillary pyocele was present in only one patient, (Table 2).

Regarding accessibility, all three approaches got accessibility to the posterior wall.

All other walls and different recesses were also accessible in case of endoscopic prelacrimal recess and canine fossa approaches. Anterior wall, medial wall and prelacrimal recess were not accessible by the middle meatal antrostomy approach. 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, (Table 3) & Fig. (6).

Zhou et al. [2] stated that, using the PLRA, all maxillary sinus areas should be easy to reach under a 0° rigid nasal endoscope. Our current study is in agreement with **Zhou** in that the 0° endoscope could be successfully used in most parts of the operation.

Postoperative complications noticed among the three groups are typically few, and usually not dangerous, (Table 4). None of those patients who underwent middle meatal antrostomy approach developed any complications. While only four patients from those underwent both PLRA & CFA, two in each group suffered crustation at site of incision. Follow up of those patients and removal of the crustations and local lubricant use, the crustations disappeared at the end of the first month.

We reported synechiae occurrence in only one patient in the trans nasal CFA between the inferior turbinate and septum in late follow up which may be due to multiple in and out application of the endoscope causing tear in the septal mucosa and opposite inferior turbinate during dissection along the anterior end of inferior turbinate, release of adhesions was done and silastic sheet was applied for one week until complete healing occurred while there was no synechiae formation in the other two groups, MMA and PLRA. Our results do not agree with a study done by **Comoglu et al.** [7] which was conducted on 12 patients operated by PLRA and reported synechiae formation in three patients.

In our study, 20% of CFA group patients had facial pain & hypothesia around the upper lip area and cheek after surgery. Only one (7.1%) patient had a facial pain at the end of the third month follow up visit.

Our results agree with **Byun and Lee** [8] study who concluded that although several complications occurred with CFA like cheek swelling, facial pain and numbness, spontaneous regression of these symptoms occurred at the end of the 3rd months after the procedure.

Also our results agree with Tran et al study who reported a case of patient who reported temporary hypoesthesia of the area of the face adjacent to the inferior aspect of the pyriform aperture and the upper lip which resolved after 6 weeks. [9]

These neurologic complications are thought to be the result of injury to the branches of the infraorbital nerve, commonly the anterior superior alveolar nerve and to less extent the middle superior alveolar nerve. [10] Damage of the infraorbital nerve in CFA is more liable and severe during periosteum elevation up to the infraorbital canal during window creation. On the other hand, damage of the nerve, in PLRA occurred as a result of thermal injury by cauterization and is transient and minimal.

And to minimize the postoperative numbness secondary to injury of branches of the anterior superior alveolar nerve, surgery should be limited to the medial side of the pyriform aperture.

In our study, cheek swelling was reported in two patients in the CFA group during the first week postoperatively, but it disappeared at the end of the first month. Our results agree with a study of 40 patients operated by CFA done by **Robinson and Wormald [10]**, who reported cheek swelling in 14 patients.

There are many complications after CFA. **Bernal-Sprekelson et al.** [11] reported anesthesia and hyopthesia occurrence for up to 2 weeks in 30% of cases and long term persistence occurred in only 6% of cases. Persisted parasthesia occurred in 3% of cases. Facial pain lasted up to 4 weeks in 25% of cases and persisted in only 2% of cases. Most discomfort sensations ended after 2–8 weeks.

Whittet et al.[12] described a similar range of complications which ranged from sneezing (9%) and numbness of the gum (26%) to pain of the cheek (61%) and swelling (78%). However, they concluded non persistence of these complications.

In our study, none of patients of the three groups reported occurrence of epiphora. **Zhou et al. [2]** described injury of the NLD in two patients during endoscopic removal of schwannoma of the infratemporal and pterygopalatine fossae via the PLRA, but neither had postoperative epiphora. This agrees with our results.

Only three (15%) patients from those who underwent middle meatal antrostomy approach had radiological and endoscopic recurrence; two of them were AFR and the third one had ACP. None of those who underwent other approaches developed either radiological or endoscopic recurrence, (Table 5).

Ismael and Abdelazim [13] concluded that patients operated by prelacrimal recess showed no recurrence during follow-up period, which agrees with our study.

Conclusion:

- Out of the three approaches, the PLRA is a safe approach for maxillary sinus lesions manipulation with minimal postoperative complications.
- Although further study of a large population is needed to establish definite indications and limitations of PLRA & CFA, our study applies a comparison between the two approaches, proving comparable disease control.
- PLRA & CFA are useful methods for diverse maxillary sinus lesions with excellent accessibility to all walls and recesses without inferior turbinate or lacrimal duct injury.
- The occurrence of facial numbness & pain after surgery was insignificant in PLRA when compared with CFA.

- During difficult surgical situations, CFA is useful and it can be done without interfering with the physiology of the sinus. It is less invasive, simple and also is functional but it has somewhat high incidence of postoperative complications like facial pain, swelling and numbness.
- Periosteum preservation of the canine fossa area can be reached through PLRA which is the site of manipulation in the CFA. Periosteum plays a role as an important barrier to prevent maxillary sinus disease invasion to the skin of the cheek. When CFA is used to remove maxillary sinus inverted papilloma, if the final pathology result shows squamous cell carcinoma, the approach site could be a spreading route. Therefore, it is an advantage of PLRA that the periosteum of the area of the canine fossa can be left as a barrier.

Limitation of the study:

- The sample size of the three groups was small and the follow up period was short (only 6 months) because our study was conducted during the era of COVID 19.
- The range of diseases of the maxillary sinus was not the same between the three groups. However, our study showed that all maxillary sinus walls can be reached and accessed; also total gross removal of the lesion can be performed through both PLRA & CFA.

Recommendations:

- Further study with long duration of follow up and wide number of patients should be done to precisely evaluate the impact of the three approaches
- Further studies should also be done to study the advantages and disadvantages of sub labial and trans nasal methods of canine fossa approach.
- Training to perform PLRA & CFA is mandatory to avoid trauma to the NLD, inferior turbinate & infraorbital nerve.

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Conflicts of interest: There are no conflicts of interest

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