Prelacrimal Versus Canine Fossa Approach for Anterior Maxillary Sinus Lesions

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Abstract

Introduction

Extensive disease in the maxillary sinus is difficult to clear with standard instrumentation during traditional endoscopic sinus surgery, so access to the anterior and anterolateral walls of the maxillary sinus is often difficult despite the creation of a large maxillary antrostomy or the use of adjuvant surgical procedures such as canine fossa puncture to gain improved access and allow for good debridement of maxillary sinus.

Objective

To study the outcome of prelacrimal approach compared to canine fossa approach for surgical treatment of anterior maxillary sinus diseases.

Patients and methods

A randomized prospective clinical study, in which a total of 40 patients with recurrent anterior maxillary sinus lesion were divided into two equal groups: Group (I) included 20 patients who underwent endoscopic prelacrimal recess approach (PLRA), and group (II) included 20 patients who underwent endoscopic canine fossa approach (CFA). Patients were evaluated between February 2018 to October 2019. The two groups were compared as regard facial pain, facial numbness, cheek swelling, nasal obstruction, epiphora, inferior turbinate destabilization, inferior turbinate nasolacrimal duct flap status, crustations, synechiae, bleeding, infection, and antrochoanal polyp recurrence.

Results

Operation time was significantly longer in CFA group II (38 minutes) compared to PLRA group I (27 minutes) (p value was <0.001). Cheek swelling was significantly higher in CFA group in comparison to PLRA group (p value <0.001). facial numbness and facial pain were significantly higher in CFA group compared to PLRA group at 1 week post operatively (p values were 0.047, 0.025 respectively). There were no significant differences between both groups as regards type of lesion and recurrence (p values were 1.0 for each).

Conclusion

Prelacrimal recess approach is a safe and simple technique for manipulation of anterior maxillary sinus lesions with short operative time and minimal postoperative complications.

Keywords: maxillary sinus, prelacrimal recess approach, canine fossa approach and endoscopic sinus surgery.

Introduction

Functional endoscopic sinus surgery is the gold standard surgical treatment in patients with chronic rhino sinusitis. It has an 80- 90% success rate in primary surgeries (**1**).

The success rate drops to 50-70% in revision surgeries (**2**). The approach to the severely diseased sinuses, especially the maxillary sinus is still controversial because of the anatomy of the maxillary sinus and the characteristics of diseases originating in it (**2**).

The maxillary sinus diseases can be grouped as: non-neoplastic (Inflammatory processes, infections, cysts, and polyps), neoplastic benign, and neoplastic malignant (**3**).

Prelacrimal recess is a concavity in the medial and anterosuperior part of the maxillary sinus (fig.1). It is located in front of the eminence of the lacrimal passages on the medial sinus wall (**2**).

The canine fossa is a depression on the anterior surface of the maxilla below the infraorbital foramen and lateral to the canine eminence and the incisive fossa (fig.2) (**4**).
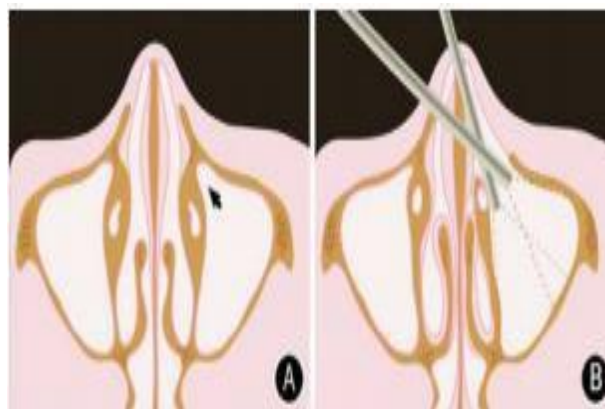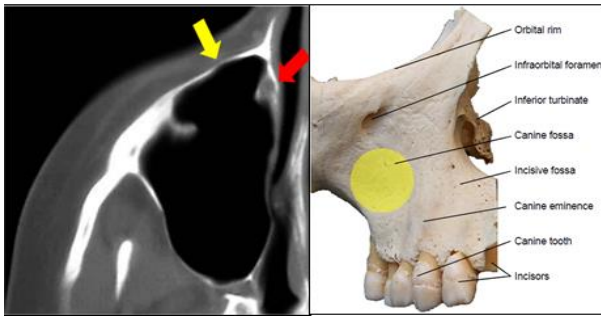

Fig.(1): Schematic diagram shows the cavity of maxillary sinus can be easily observed under 0 degree rigid endoscope via the prelacrimal recess approach. Arrow prelacrimal recess (8).

Fig.(2): Canine fossa; **A**. Thin bone of canine fossa(yellow arrow); nasolacrimal duct (red arrow) **B**. Right canine fossa (yellow), incisive fossa and canine eminence **(9).**

Extensive disease in the maxillary sinus is often difficult to clear with traditional endoscopic sinus surgery so access to the anterior and anterolateral walls of the maxillary sinus is often difficult despite the creation of a large maxillary antrostomy or the use of adjuvant surgical procedures such as canine fossa puncture to gain improved access and allow for good debridement of maxillary sinus **(5).**

It is common to access the anterior part of the maxillary sinus through a canine fossa puncture. Such punctures were performed by making a small incision through the oral mucosa and penetrating the thin bone of the fossa with a trocar **(6).**

The endoscopic prelacrimal recess approach provides a clear view. It provides accurate, minimally invasive and complete removal of benign maxillary sinus lesions. It is a physiological and functional surgery, and has great advantages in treating the diseases of the nose and paranasal sinuses **(7).**

Patients and Methods

A randomized prospective clinical study in which 40 patients were divided randomly by sealed envelopes who underwent endoscopic nasal surgery, 20 of them underwent endoscopic prelacrimal approach and the other 20 underwent endoscopic canine fossa approach for recurrent anterior maxillary lesions. The average age ranged from 17 up to 45 years, 25 were males and 15 were females. Patients were selected from those attending the ENT outpatient clinic at Benha University Hospitals presenting with unilateral maxillary sinus lesion.

The study was approved by the local ethical committee of Benha University and an informed consent was taken from patients before participating in the study.

**Inclusion criteria:** recurrent anterior maxillary sinus lesions.
Exclusion criteria: patients with age less than 17 years old, maxillary sinus malignant tumors and patients with bleeding tendency.
Preoperative Endoscopic examination of the nose, paranasal sinuses and nasopharynx in addition to multislice computerized tomography scan were done.
## Surgical details

All surgeries were performed under general anesthesia. Maxillary middle meatal antrostomy and uncinectomy were done unless if it had been performed in previous surgery. In both groups, the part of the lesion that was extending from the maxillary sinus (MS) to inside the nasal cavity and choana was resected through the middle meatus using different angled nasal endoscopes.

In **PLRA Group (I);** we used the same standard technique of Zhou et al. **(10)** in which local hemostasis was achieved by injecting 2 ml of 1% xylocaine and adrenaline 1:200,000 into the nasal septum, inferior turbinate and lateral nasal wall adjacent and anterior to the inferior turbinate (fig.3a). A curved mucosal incision on the lateral wall of the nasal cavity was made between the anterior aspect of the inferior turbinate and the edge of the pyriform aperture to the bone (Fig.3b). The mucosa from the subperiosteal level was elevated posteriorly to the insertion site of the inferior turbinate and then the bony attachment of the inferior turbinate (IT) was disconnected (fig.4a). The bony inferior orifice of nasolacrimal duct (NLD) could be seen after the mucoperiosteum was elevated posteriorly. We chiseled off the anterior bony portion of the medial wall of the maxillary sinus (part of the maxillary frontal process), and after chiseling the bone posteriorly, the NLD was exposed and the inferior turbinate nasolacrimal duct (IT-NLD) flap was formed (Fig.4 b&c). The IT-NLD flap was pushed medially and the antero-medial wall of the maxillary sinus was exposed (Fig.5a). The maxillary sinus was entered through the antrostomy made at the prelacrimal recess (Fig.5b). The maxillary sinus was exposed widely when the antrostomy was adequately enlarged, and all pathological tissues were removed under direct visualization with 0 degree telescope (Fig.5c). The IT-NLD mucosal flap was repositioned and the incision was sutured at the end of the operation (Fig.6a).
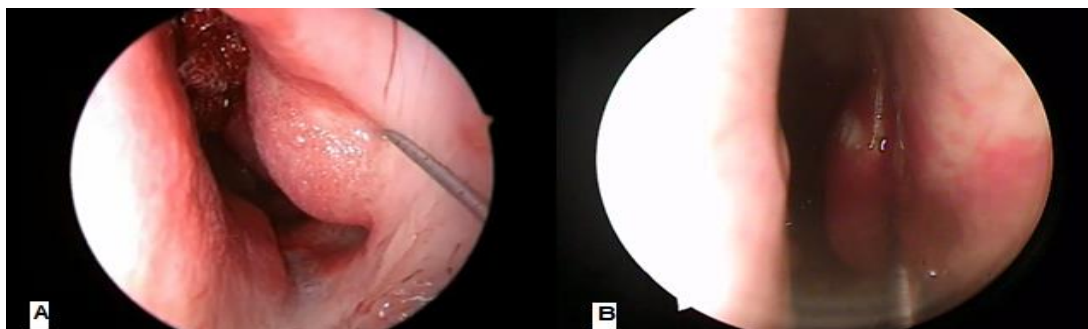

Fig (3) steps of PLRA : **A**. injection of diluted adrenaline at site of incision. **(B).** A curved mucosal incision between the anterior end of the inferior turbinate (IT) and posterior end of the nasal vestibule.
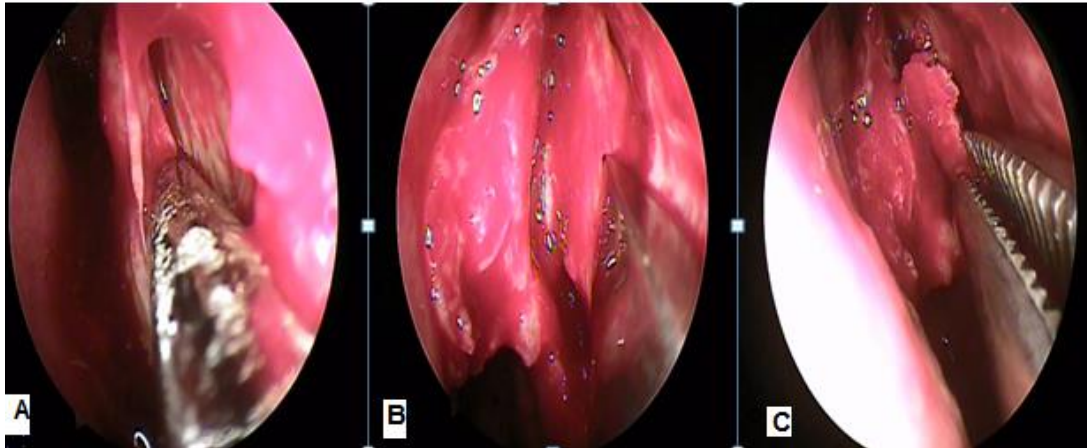
Fig (4) A. Mucoperiosteum elevated posteriorly until the attachment of inferior turbinate (IT), **B & C.** chiseling of the anterior bony portion of the medial wall of the MS.
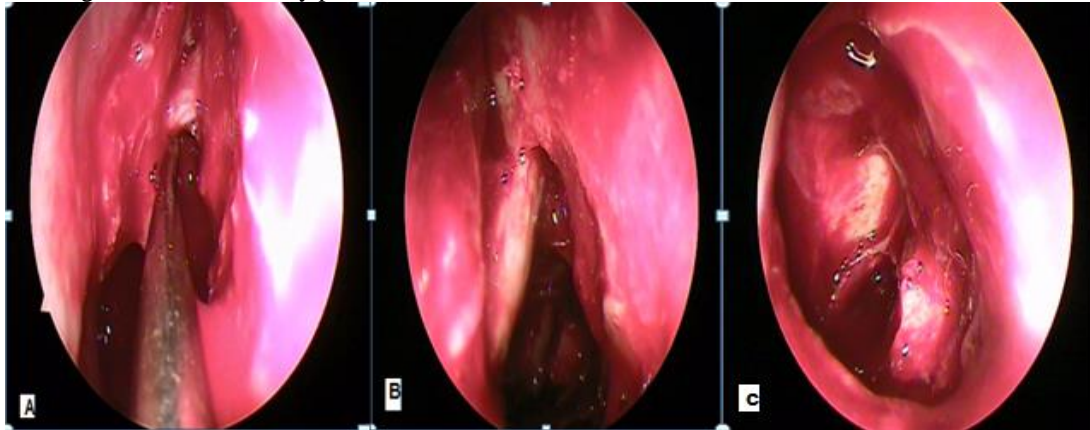

Fig (5) A. chiseling of bone posteriorly to expose NLD, **B.** partial removal of anteromedial bony wall of the MS, **C.** close endoscopic view of the entire maxillary sinus throw the prelacrimal recess opening.
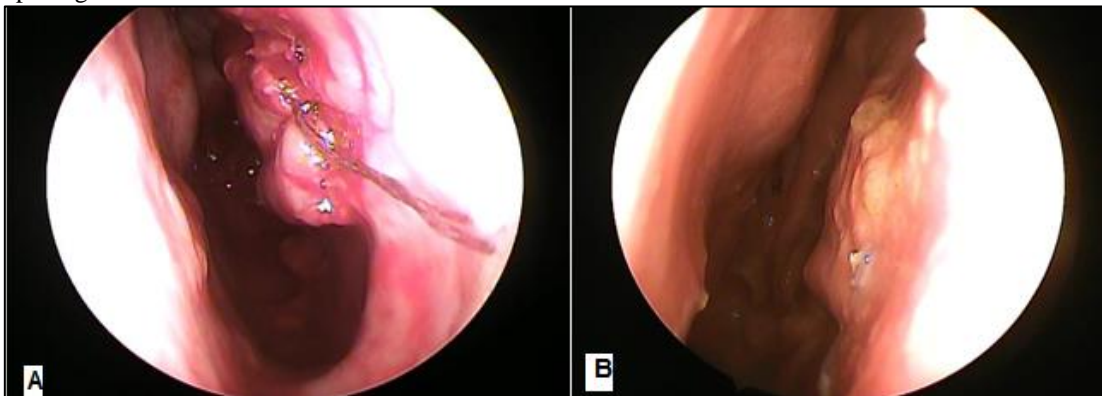
Fig (6) A. endoscopic view of left nasal cavity showing closure of the incision by absorbable sutures, **B.** endoscopic view of the incision 4 weeks postoperative.

In **CFA Group (II)**; canine fossa puncture was performed after infilteration of the sublabial region with 2 ml of 1% xylocaine and adrenaline 1:200,000, then a small incision 3 mm above the line of reflection and starting at the canine ridge runs laterally for 3.5–4 cm parallel to the teeth was made. Penetrating the thin bone of the fossa with a trocar using a gentle twisting motion **(11)**. In some patients with thicker bone, gentle tapping with a hammer was required for the trocar to be inserted **(12)**, the antrostomy was 4-mm in diameter and was widened using an osteotome to allow instrumentation of the maxillary sinus, polyps and diseased tissue were removed from the maxillary sinus, and closure of the sublabial incision was done using 3-0 absorbable Vicryl sutures **(fig.7)**.
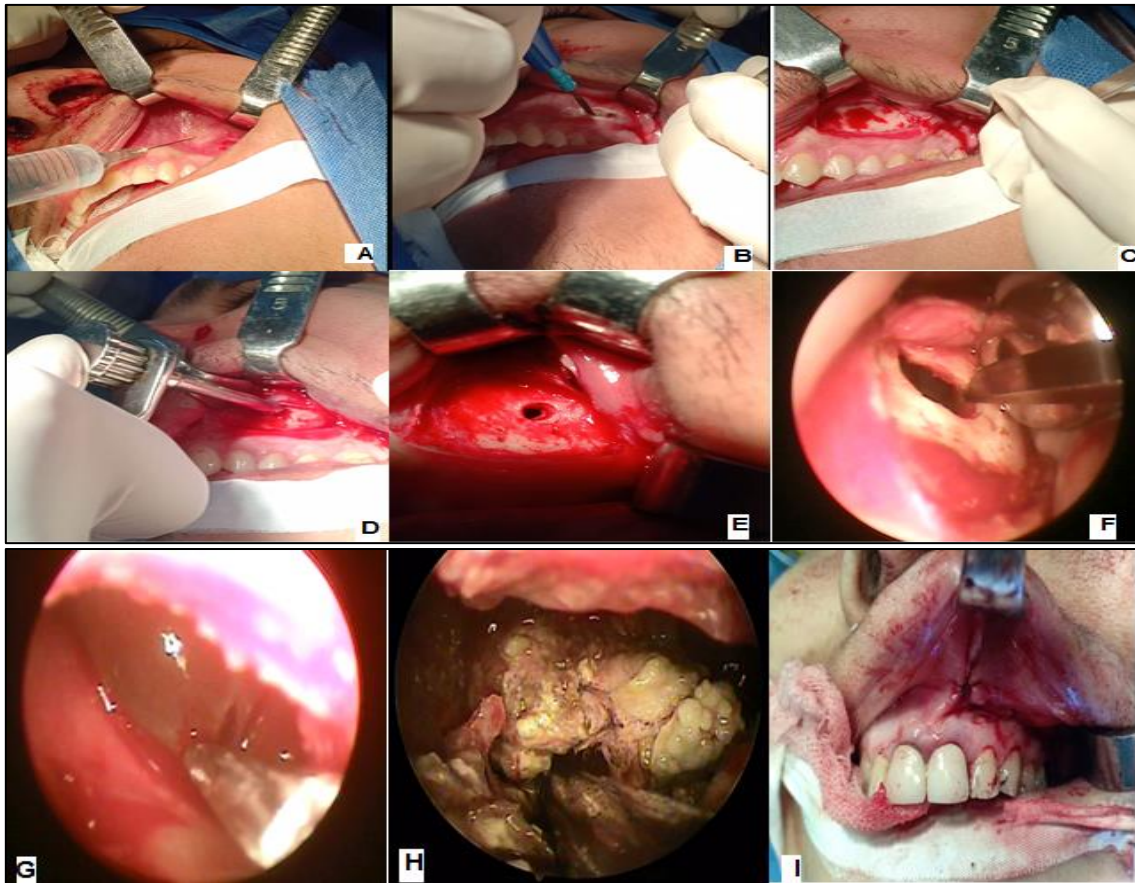
Fig (7) steps of CFA: A. injection of diluted adrenaline at the site of sublabial incision, **B.** sublabial incision corresponding to canine fossa, **C**. widening of incision exposing bon of canine fossa, D&E. penetrating the thin bone of the fossa with a trocar using a gentle twisting motion, **F**. widening of the opening by chisel, G. endoscopic view of maxillary sinus pathology (polyp) throw canine fossa opening, **H**. canine fossa endoscopic view showing fungal ball, **I**. repositioning of the flap and closure of the incision.

Follow-up : All patients included in this work attended postoperative follow-up visits weekly for 1 month, followed by monthly visits for 3 months, and then at 6 months.

All patients were subjected to :

Subjective assessment:

All patients were asked about any facial pain, facial numbness, cheek swelling , nasal obstruction and epiphora.

Facial was assessed using Visual analogue scale (VAS) **(13)** (**fig.8**).

Epiphora was assessed using fluorescin disappearance test by instilling a drop of sterile 2% fluorescein into the conjunctival fornices of the eye to be examined and then observes the tear film. Persistence of significant dye inadequate clearance of the dye from the tear meniscus over a 5-minute period indicates an obstruction.

Objective assessment :

The postoperative evaluation in the follow-up visits included nasal endoscopic evaluation of the IT destabilization, , crustations, and synechiae, bleeding, IT-NLD flap status, infection and antrochoanal polyp recurrence

Statistical methods

- Data management and statistical analysis were done using SPSS vs.25. (IBM, Armonk, New York, United states).
- Numerical data was summarized as means and standard deviations.
- Categorical data was summarized as numbers and percentages.
- Comparisons were done between both groups using Mann Whitney U test for numerical data.
- Categorical data was compared using Chi-square test or Fisher's exact test if appropriate.
- All p values were two sided. P values less than 0.05 were considered significant.

Results

The study included 40 patients with recurrent anterior maxillary sinus lesion, and they were classified into two groups: Group (I) included 20 patients; eleven (55%) patients were men, and nine patients (45%) were female. Male to females ratio was 11: 9. Their ages ranged from 19 to 45 years with an average age 30 ± 9 years and group (II) included 20 patients; thirteen (65%) patients were men, and seven patients (35%) were females. Male to female ratio was 13: 7. Their ages ranged from 18 to 44 years with an average age 29 ± 9 years (Table 1).

There were no significant differences between both groups as regard age, gender and type of lesions. P values were 0.896, 0.519 and 1.0 respectively (table 1).

Intraoperative

Operation time was significantly longer in group II (38 minutes) compared to group I (27 minutes). P value was <0.001 (Table 1).

There were no significant differences between both groups as regard IT destabilization and bleeding. P values were 0.231 & 0.168 respectively (Table 2).

Bleeding was moderate in amount (frequent suctioning required and bleeding threatens surgical field directly after suction is removed).

Table (1) Comparison between the studied groups as regard to age distribution, gender, operation time and type of lesion

		Group I (n = 20)	Group II (n = 20)	P value
Age	Mean ±SD	30 ±9	29 ±9	0.896
Gender	Males n (%)	11 (55.0)	13 (65.0)	0.519
	Females n (%)	9 (45.0)	7 (35.0)	
Operation time	Mean ±SD	27 ±7	38 ±6	<0.001
Lesions	Antrochoanal polyp	9 (45.0)	9 (45.0)	1.0
	Fungal ball	2 (10.0)	1 (5.0)	
	Fungal sinusitis	4 (20.0)	5 (25.0)	
	Inverted papilloma	2 (10.0)	1 (5.0)	
	Maxillary cyst	3 (15.0)	4 (20.0)	

Mann Whitney U test was used for age and operation time. Chi-square test was used for categorical data

Table (2) Comparison between the studied groups as regard to intraoperative IT destabilization and bleeding

		Group I		Group II		
		n	%	n	%	P value
IT destabilization	Yes	3	15.0	0	0.0	0.231
bleeding	Yes	4	20.0	8	40.0	0.168

Chi-square test was used

Table (3) Comparison between the studied groups as regard post-operative facial pain and numbness, cheek swelling, epiphora, crustations, synechiae, bleeding, IT-NLD flap status, infection and antrochoanal polyp recurrence.

		Group I		Group II		
		n	%	n	%	P value
Facial pain						
At 1 week	Yes	8	40	15	75	0.025
At 1 month	Yes	4	20	9	45	0.091
At 2months	Yes	2	10	5	25	0.407
At 6 months	Yes	1	5.0	3	15	0.605
Facial numbness						
At 1 week	Yes	4	20.0	10	50.0	0.047
At 1 month	Yes	3	15.0	6	30.0	0.451
At 2months	Yes	3	15.0	6	30.0	0.451
At 6 months	Yes	1	5.0	5	25.0	0.182
Cheek swelling						
At 1 week	Yes	4	20.0	15	75.0	<0.001
At 1 month	Yes	1	5.0	10	50.0	0.001
At 2months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
Epiphora						
At 1 week	Yes	1	5.0	0	0.0	1.0
At 1 month	Yes	1	5.0	0	0.0	1.0
At 2months	Yes	1	5.0	0	0.0	1.0
At 6 months	Yes	1	5.0	0	0.0	1.0

Crustations						
At 1 week	Yes	8	40.0	0	0.0	0.003
At 1 month	Yes	0	0.0	0	0.0	-
At 2months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
Synechiae						
At 3 weeks	Yes	2	10.0	0	0.0	0.487
At 1 month	Yes	0	0.0	0	0.0	-
At 2months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
Bleeding						
At 1 week	Yes	1	5.0	3	15.0	0.605
At 1 month	Yes	0	0.0	0	0.00	-
At 2months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
IT-NLD flap status						
At 1 week	Yes	2	10.0	0	0.0	0.487
At 1 month	Yes	0	0.0	0	0.0	-
At 2months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
Infection						
At 1 week	Yes	1	5.0	3	15.0	0.605
At 1 month	Yes	0	0.0	0	0.0	-
At 2 months	Yes	0	0.0	0	0.0	-
At 6 months	Yes	0	0.0	0	0.0	-
Antrochoanal polyp recurrence						
At 6 months	yes	1	5.0	2	10.0	1.0

Chi-square test or Fisher's exact test was used

Postoperative data

postoperative follow-up visits were weekly for 1 month, followed by monthly visits for 3 months, and then at 6 months.

Facial pain

Facial pain was significantly higher in group II (75.0%) compared to group I (40.0%) at 1 week post operatively (p value 0.025).

There were no significant differences between both groups at 1 month (p value 0.091), 2 months (p value 0.407), and six months (p value 0.605) (Table 3).

Facial numbness

Facial numbness at the upper central and lateral incisors was significantly higher in group II (50.0%) compared to group I (20.0%) at 1 week post operatively (p value 0.047).

There were no significant differences between both groups at 1 month (p value 0.451), 2 months (p value 0.451) and six months (p value 0.182) (Table 3).

Cheek swelling

Cheek swelling was significantly higher in group II compare to group I postoperatively at 1 week (p value <0.001), at 1 month (p value was 0.001).

There was no patient complaining of cheek swelling in both studied groups from cheek swelling at 2, 6 months postoperatively (Table 3).

Nasal obstruction

There were no significant differences between both groups as regard nasal obstruction at all follow up points. At 1 week postoperatively p value was 0.749 and at 1 month p value was 0 (Table 3).

Epiphora

There were no significant differences between both groups as regard epiphora at all follow up points (p value 1.0) (Table 3).

The postoperative evaluation in the follow-up visits included nasal endoscopic evaluation of:

Crustations

Crustations at incision site were significantly higher in group I (40%) compared to group II (0.0) at 1 week postoperatively (p value was 0.003) (Table 3).

There were no significant differences between both groups at rest of follow up points.

No crustations at incision site reported after 1 month postoperatively in both groups.

Synechiae:

There were no significant differences between both groups as regard synechia at all follow up points. p value at 3 weeks postoperatively was 0.487. Synechiae in group I appeared between the lateral nasal wall (particularly on the inferior edge of the mucosal flap) and septum just superior to the inferior turbinate and

was treated appropriately (Table 3).

Bleeding

There were no significant differences between both groups as regard bleeding at all follow up points. At 1 week p value was 0.605 (Table 3). Bleeding was moderate in amount and presented within the first month postoperatively and controlled by anterior nasal packing.

IT-NLD flap status

There were no significant differences between both groups as regard IT-NLD flap status at all follow up points. At 1 week postoperatively p value was 0.487.

two patients (10%) had a small bare area in group I, which healed spontaneously after 1 month, whereas in group II there was no disturbance of the IT or NLD area (Table 3).

Infection

There were no significant differences between both groups as regard infection at all follow up points. At 1 week postoperatively p value was 0.605 (Table 3).

Endoscopic examination of these patients showed edematous and hyperemic mucosa with yellowish purulent discharge. Parentral antibiotics were given.

Antrochoanal polyp recurrence

There were no significant differences between both groups as regard antrochoanal polyp recurrence. P value was 1.0   Recurrence detected by computed tomography scan done sixth months postoperatively (Table 3).

Two cases of canine fossa approach show open sublabial incision at two weeks follow up interval period and need reclosure of the incision with 3-0 absorbable vicryl sutures.

Discussion

According to the anatomy of maxillary sinus and the characteristics of the diseases originating from it, which were assessed with multiangulated telescopes, including 30 and 70 telescopes, with different kinds of curved instruments, there are still some hidden areas that cannot be viewed and handled **(2).**

Our study conducted on 40 patients and divided into two groups : group I included patients operated through prelacrimal approach, and were as follows; Nine patients (45%) with antrochoanal polyp, four patients (20%) with fungal sinusitis, three patients (15%) with maxillary cyst, two patient (10%) with fungal ball and one patient (10%) with inverted papilloma. while group II patients operated through canine fossa approach (CFA) were as follows; Nine patients (45%) with antrochoanal polyp, five patients (25%) with fungal sinusitis, four patients (20%) with maxillary cyst, one patient (5%) with fungal ball and one patient (5%) with inverted papilloma.

In our study there were no significant differences between both groups as regard age distribution, gender distribution and type of lesions (p values were 0.896, 0.519 and 1.0 respectively)**.**

As regards mean operation   time, it was significantly longer in CFA group (38 minutes) compared to PLRA group (27 minutes) (p value was < 0.001). This observation is in agreement with the results of Al Ayadi et al. **(8)** study in which the mean operation time of the PLRA was 30 minutes.

In our study, postoperative bleeding was found in only one (5%) patient in PLRA group and three (15%) patients in CFA group. It was moderate bleeding and managed by anterior nasal pack in the outpatient clinic and the difference was statistically insignificant at all follow up points (p value was 0.605).

Our study is agreed with Sathananthar et al**. (13)** who reported that there were no patients who operated by CFA had arterial bleeding from the antrostomy site intra- or postoperatively.

In our study facial numbness was significantly higher in CFA group as 10 patients (50.0%) complained of numbness at the upper central and lateral incisors compared to PLRA group whereas four patients (20.0%) complained of numbness at 1 week post operatively (p values were 0.047 for each). By the end of sixth month follow up interval there was one patient (5%) who continued to complain of facial numbness at the upper central and lateral incisor in PLRA Group, but in CFA Group there were five patients (25%) continued to complain of facial numbness. This agreed with weber et al. **(14)** study that reported only one individual had persistent facial numbness among 20 patients underwent PLRA.

Facial numbness is thought to be caused by injuries to the branches of the infraorbital nerve, principally the anterior superior alveolar nerve and less commonly the middle superior alveolar nerve (**16**). The damage of infraorbital nerve in CFA is more liable and sever due to injury of the nerve when elevating periosteum up to the infraorbital canal during creation of the antral window in CFA. Otherwise in PLRA damage of the nerve which could be happened because of thermal injury by cauterization is transient and minimal.

Al Ayadi et al. **(8)** study gave nearly the same results of our study regarding facial numbness that occurred in the upper central incisors at the PLRA side in five patients (25%) as early as at 2 weeks postoperatively, during follow up period only one patient (5%) continued to complain of numbness for 2 years postoperatively.

Weber et al. **(14)** reported that in PLRA facial numbness is caused by a lesion of the superior alveolar nerve, which runs through the bone of the anterior MS wall**.**

As regards facial pain, it was significantly higher in CFA group (75.0%) compared to PLRA group (40.0%) post operatively at 1 week (p values were 0.025 for each). By the end of the 6 month we reported only one patient complaining of facial pain in PLRA group in comparison to three patents in CFA group. This observation is in agreement with the results of Robinson et al. **(5)** study that reported facial pain in 12 patients (32%) operated with CFA and by the end of sixth month follow up interval only one patient (7.1%) was still complaining of facial pain**.** Facial pain may be due to extensive cauterization during creation of sublabial incision or due to injury of the infraorbital

nerve or superior alveolar nerve .

Al Ayadi et al. **(8)** reported one patient with facial pain at the PLRA side and this facial pain was due to extensive use of drill.

In our study cheek swelling was significantly higher in CFA group in comparison to PLRA group post operatively at 1 week (p value <0.001), at 1 month (p value was 0.001). One week postoperatively four patients (20%) of PLRA group developed cheek swelling in comparison to 15 patients (75%) developed cheek swelling in CFA group and by the end of the second month there was no cheek swelling in both groups. This observation is nearly in agreement with results of Robinson et al. **(5)** study that reported cheek swelling in 14 patients (38%) operated by CFA **.**

Byun JY and Lee JY **(15)** study reported that although several complications occurred with CFA (e.g., cheek swelling, facial pain and numbness), these symptoms resolved spontaneously with no symptom persisting at 3 months after the procedure and these results don't agree with our result in CFA group as facial numbness and facial pain persists after 3 months post operatively.

Comoglu et al. **(17)** study conducted on 12 patients operated by PLRA reported that three patients (25%, 3/12) had synechiae, while our study reported two patients (10%, 2/20) of PLRA group had synechiae.

In our study only one patient was complaining of persistent epiphora in PLRA group while in CFA group there was no patient complaining of epiphora, the difference between both groups was statistically insignificant (p value was 1.0).

Zhou et al. **(18)** reported NLD injury occurred in two patients during endoscopic removal of schwannoma of the pterygopalatine and infratemporal fossae via the prelacrimal recess approach but neither had epiphora postoperatively which isn't agreed with our study in which one patient complained of persistent epiphora following PLRA.

Ismaeil and Abdelazim **(19)** reported no recurrence in patients operated by prelacrimal recess during follow-up period which is not agreed with our study as we reported three cases.

Zhou et al. **(20)** study reported a disadvantage of PLRA that the inferior turbinate-nasal lacrimal duct mucosal flap is re-draped onto its original position, so the anterior half of the maxillary sinus and zygomatic recess laterally is difficult to be evaluated even with the use of flexible endoscopy post-operatively. In our study no cases reported with disturbed IT- NLD mucosal flap .

Al Ayadi et al. **(8)** done a comparative study of the incidence of complication after prelacrimal approach and endoscopic sinus surgery of maxillary sinus lesions and reported that the PLRA is a minimally invasive technique, with minimal complications in the form of facial numbness 25%, facial pain 25%, facial swelling , bleeding 5%, crustations 95%, synechiae 15%, epiphora 5% and IT-NLD flap disturbance 15%. This agreed with our study.

Zhou et al. **(10)** stated that, by means of the PLRA,

all areas of the MS should be easy to reach under a 0° rigid nasal endoscope. This is in agreement with our current study in that the 0° endoscope could be used successfully in most parts of the operation.

The main advantage of PLRA is a wide surgical field for all maxillary sinus walls without violation of the nasolacrimal duct and inferior turbinate. Our study showed that benign maxillary sinus tumors attached to various sites of the maxillary sinus could be removed, and gross total resection is possible. In addition PLRA can preserve the periosteum of the canine fossa area, which is the manipulated site of the CFA. Periosteum plays a role as a primary barrier to prevent maxillary sinus disease from invading the skin of the cheek. When CFA is performed for maxillary sinus inverted papilloma, if the final pathology result is confirmed as squamous cell carcinoma, the approach site could become a spreading route **(21)**. Therefore, PLRA has an advantage that the periosteum of the canine fossa area can be left as a barrier.

Conclusion

prelacrimal recess approach is a safe technique for manipulation of anterior maxillary sinus lesions with short operative time and minimal postoperative complications.

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