



Evaluation of Role of Minimally Invasive Sinus Technique (MIST) in patients of Chronic Rhinosinusitis

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Abstract

Background: *MIST is stepwise intranasal intervention with defined beginning and end for all patients regardless of disease severity, there by standardizing the procedure for surgeons and patients alike. In the present study the role of minimal invasive sinus technique is evaluated in terms of both a surgical modality of choice and patients satisfaction. This study is done to assess the indications, techniques, results of MIST, And to assess the efficacy and reliability of MIST.*

Material and Method: *This prospective study is conducted in the department of otorhinolaryngology, Index Medical College Hospital and Research Centre, Indore from Sep 2014 to Sep 2016. A total of 60 patients (age ranged from 9 years to 50 years) having nasal and sinus complaints were selected. Detailed Clinical evaluation, preoperative diagnostic nasal endoscopy, CT Para-nasal sinus was done and MIST was performed in all cases. Post-operative subjective improvement was assessed.*

Result: *The main symptoms in the study group was nasal obstruction followed by nasal discharge. On anterior rhinoscopic examination DNS was seen followed by ITH. Pre-operative nasal endoscopy showed MPD in OMC followed by MPD in ET, polyp was also seen in cases. The most striking anatomical variants seen after pre-operative nasal endoscopy was swollen agger nasi cells followed by Overpneumatized bulla, medially bent U.P, laterally bent U.P, polypoid U.P and paradoxically bent M.T. these findings were confirmed on CT PNS. Various surgical procedures were performed including uncinectomy followed by CB exteriorization, opening of bulla, anterior ethmoidectomy, posterior ethmoidectomy and sphenoidectomy. Post-operative subjective improvement was assessed in every patient. No major post-operative complication occurred in this study.*

Conclusion: *Our study shows that MIST is a safe and effective method of treatment in cases of Chronic Rhino-sinusitis in all age group of patients , by providing better understanding of sinus pathophysiology and opens the new horizons of treating them with minimal injury to the surrounding normal mucosa.*

Keywords: *MIST, CHRONIC RHINOSINUSITIS, FESS.*

Introduction

The aim of any surgery is to inflict minimal trauma to the surrounding tissues resulting in less

swelling; less edema, less pain and less morbidity with optimal successful results from the patient's point of view both anatomically and physiologi-

cally. Nasal symptoms are among the commonest reasons for which a patient seeks Rhinologist's advice. More so the management of these symptoms forms a significant part of workload of Rhinologist's. With rapid advancement and increased availability of newer technology, surgical interventional techniques are getting refined and perfected.

Originally, proponents of FESS emphasized that it provides a conservative and effective surgical intervention, rarely requiring a middle meatal antrostomy or stripping of diseased nasal mucosa. Over time however, there has been a departure from these conservative principles, with tendencies towards more aggressive intervention. Minimally Invasive Sinus Technique (MIST) is true embodiment of Messerklinger's functional concept and an improvement in FESS by providing an anatomical based, reproducible approach to sinus surgery.

MIST is based on exact identification of focal disturbances, refined surgical interventions and functional restoration of aeration and drainage of various sinuses by Muco-ciliary clearance.

MIST is much more than not performing a middle meatal antrostomy. The procedure is only step wise intranasal intervention with defined beginning and end for all patients regardless of disease severity, there by standardizing the procedure for surgeons and patients alike. It is important to state that minimally invasive technique is not minimal surgery, but the invasion into the nose and sinus is minimal. This also enables the surgeon to preserve important surgical landmarks to avoid serious intraorbital and intracranial complications, which can occur during endoscopic sinus surgery. It is an attractive alternative to traditional headlight approaches to nasal surgery.

In the present study the role of minimal invasive sinus technique is evaluated in terms of both a surgical modality of choice and patients satisfaction.

Material and Method

This prospective study is conducted in the department of otorhinolaryngology, Index Medical College Hospital and Research Centre, Indore from Sep 2014 to Sep 2016.

A total of 60 patients (age ranged from 9 years to 50 years) having nasal and sinus complaints were selected. The patients were considered to have rhinosinusitis when they had nasal congestion, nasal obstruction, rhinorrhea, headache etc. The patients having these symptoms and sign for more than one month and all those who were treated conservatively for one month prior to this study were selected. Detailed Clinical evaluation, preoperative diagnostic nasal endoscopy, CT Para-nasal sinus was done and MIST was performed in all cases. Post-operative subjective improvement was assessed.

Different Surgical Rprocedures For Isolated Pathologies

The different surgical procedures performed such as :-

1. Correction of high deviated nasal septum with removal of spur
2. Middle turbinate – concha bullosa & paradoxical turbinate
3. Uncinate process and maxillary ostium reconstruction at physiological site.
4. Bulla ethmoidalis
5. Frontal recess
6. Posterior ethmoids
7. Sphenoid sinus

We have assessed the post-operative subjective improvement of patients undergoing MIST by asking questions regarding subjective improvement of their symptoms in post-operative follow-up period.

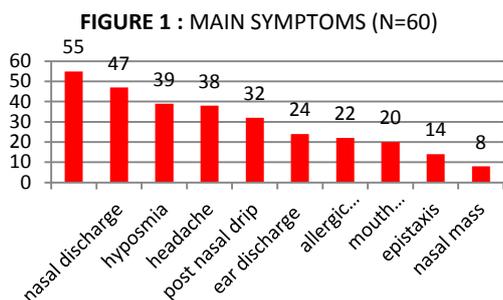
After assessing the individual response (postoperatively) regarding their symptomatology and improvement in it, patients were divided into three categories.

Category-I- Patients with complete satisfaction after surgery regarding their symptoms.

Category-II- Patients with general satisfaction post operatively.

Category-III- Patients with no improvement.

Result



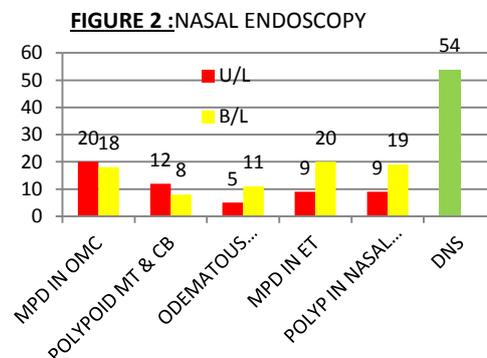
The main symptom in the group of patients (figure 1 and table 1) was nasal obstruction seen in 55 (91.66%) cases. Out of which 12 cases had continuous, 43 recurrent, 45 bilateral and 10 unilateral nasal obstruction. Nasal discharge was seen in 47 (78.33%) cases which was watery in 08 cases, mucoid in 19 cases and mucopurulent in 11 cases. Hyposmia in 39(65%) cases, headache in 38(63.3%) cases, PND in 32(53.3%) cases, ear discharge in 24(40%) cases, allergic symptoms in 22(36.6%) cases, mouth breathing in 20 (33.3%) cases, epistaxis in 14 (23.3%) cases and nasal mass in 08(13.3%) of cases.

Table 1:-Main Symptoms During Clinical Examination (N=60)

SYMPTOMS	NO. OF CASES	%
Nasal obstruction	55	91.66
Nasal discharge	47	78.33
Hyposmia	39	65
Epistaxis	14	23.3
Headache	38	63.3
Mouth breathing	20	33.3
Nasal mass	08	13.3
Post nasal drip	32	53.3
Allergic symptoms	22	36.6
Ear discharge	24	40

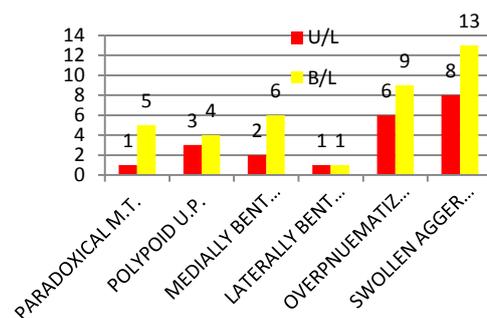
On anterior rhinoscopic examination the most obvious finding was DNS in 56 (93.33%) patients, inferior turbinate hypertrophy (ITH) was noted 26(43.33%) cases out of which 15(25%) were unilateral and 11(18.33%) were bilateral. Middle turbinate hypertrophy (MTH) was seen in total of 29(48.33%) of cases out of which 22(36.67%) were unilateral and 7(11.67%) were bilateral. Polyp was noted in 22(36.67%) cases out of which

6(10%) cases were unilateral and 18(30%) cases were bilateral. Mucopurulent discharge was seen in total of 11(18.33%) cases of which 5(8.33%) were unilateral and 6(10%) cases bilateral. Sinus tenderness was elicited and came to be positive in 26(43.33%) cases.



Pre-operative nasal endoscopic evaluation showed various pathological abnormalities (figure 2). DNS was seen in 54(90%) cases in contrast to anterior rhinoscopic examination DNS was found to be in 56 cases. Polypoidal MT or concha bullosa was seen in 20(33.33%) cases of which 12(20%) were unilateral and 08(13.33%) bilateral. MPD in OMC was seen in 38(63.33%) cases out of which 20(33.33%) unilateral and 18(30%) bilateral. MPD in ET was seen in 29(48.33%) cases of which 09(15%) were unilateral and 20(33.33%) were bilateral. Polyp was noted in nasal cavity in 28(46.67%) cases of which Ethmoidal polyp was seen in 21(35%) patients out of which 18(30%)were bilateral and 3(5%) had unilateral ethoidal polyp. And 6(10%) had unilateral antrochoanal polyp. And the most striking finding encountered was nasal cholesteatoma detected in 1(1.67%) of cases.

FIGURE 3 : ANATOMICAL VARIATIONS ON NASAL ENDOSCOPY



After undergoing Pre-operative nasal endoscopy patients were also found to have some anatomical variants as shown in figure 3. The most striking variant was swollen agger nasi cell in 21(35%) cases of which 8(13.3%) cases unilaterally and 13(21.67%) cases bilaterally. Overpneumatized bulla was seen 15(25%) cases of which 6(10%) were unilateral and 9(15%) bilateral other anatomical variations detected were paradoxically bent middle turbinate 6(10%) cases, polypoid uncinata process in 7(11.67%), medially bent uncinata process 8(13.3%), laterally bent uncinata process 2(3.33%).

There are different CT patterns of sinonasal pathology

1] Infundibular pattern:-This is the most limited of the obstructive pattern and diagnosed when there is disease limited to maxillary sinus with obstruction visualized with ipsilateral maxillary ostium/infundibulum.

2] Osteomeatal unit pattern (OMU):-it is caused by occlusion of middle meatus by inflammatory involvement of ipsilateral frontal, anterior and middle ethmoid and maxillary sinus which drain into it. This pattern is quite frequent about 25%.

3] Spheno-ethmoidal recess pattern:-Variable involvement of ipsilateral posterior ethmoidal and sphenoid sinuses and occurs when inflammatory posterior nasal pathology lead to obstruction of sinus ostia in spheno-ethmoidal recess.

4] Sinonasal polyposis pattern (SNP):- Here extensive inflammatory condition leading to polypoid mucosa of nose and PNS with characteristic radiological re-appearance. Medical treatment using steroid is main stay of therapy. FESS is reserved for those patient who do not respond to vigorous medical therapy.

5] Sporadic or unclassified pattern:-Sinonasal disease which cannot be categorized into above 4 patterns is included in this group. This includes findings as retention cyst, mucocele, mild mucoperiosteal thickening and post-operative changes after FESS.

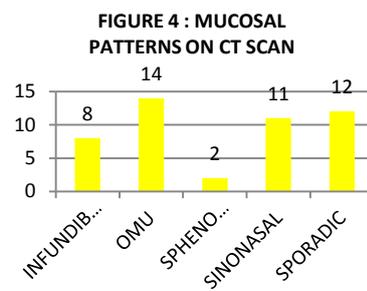


Table 2:-Anatomical Variants Found During Ct Study

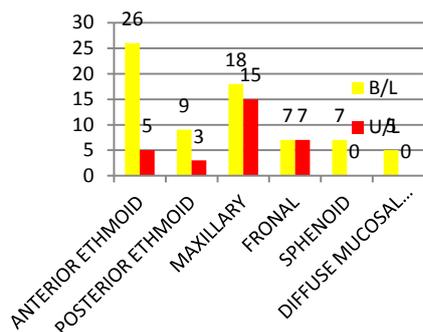
VARIANTS	TOTAL NO.	%	U/L	%	B/L	%
MEDIANLY BENT U.P.	05	10.6	02	4.25	03	6.38
LATERALLY BENT U.P.	01	2.1	-	-	01	2.1
POLYPOID U.P.	03	6.38	01	2.1	02	4.25
CONCHA BULLOSA	19	40.4	08	17.02	11	23.4
PARADOXICAL MT	05	10.6	01	2.1	04	8.51
OVERPENUMATIZED BULLA	06	12.7	02	4.25	04	8.51
HALLER CELLS	06	12.7	05	10.6	01	2.1
AGGER NASSI	39	82.9	11	23.4	28	59.5

Mucosal patterns shown in our study (figure 4), of which most common being osteomeatal unit pattern seen in 14(29.78%) cases followed by sporadic pattern seen in 12(25.5%) cases, sinonasal pattern seen in 11(23%) cases, infundibular pattern in 8(17.02%) cases and least being sphenoethmoidal pattern seen in 2(4.25%) cases.

All the patients were radiologically evaluated after which mucosal abnormality detected on coronal section of C.T. paranasal sinuses. The most frequent involved sinus area was anterior ethmoid region in 60.6%. mucosal sinus abnormality in maxillary sinus accounted 54%. Sphenoid sinus was involved in 14%. The diffuse inflammatory mucosal response with turbinate hypertrophy was seen in 10.6% cases. (Figure 5)

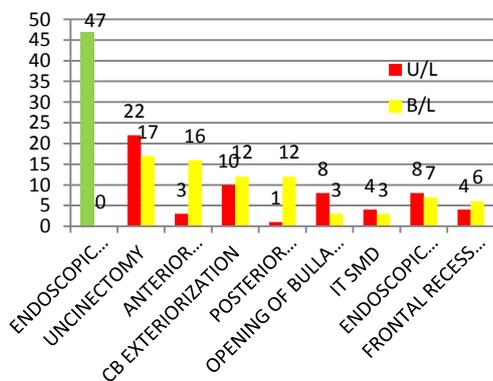
The most commonest of various anatomical variation noted in pre-operative CT study(table 2) was swollen agger nasi seen in 39(82.9%) cases of which 11(23.4%) were having unilateral and 28(59.5%) bilateral, this finding was consistent with nasal endoscopy(figure 3). Concha bullosa was seen in 19(40.4%) patients of which 8(17.02%) were unilateral and 11(23.4%) bilateral.

FIGURE 5 : MUCOSAL ABNORMALITIES IN SINUSES ON CT



Various other anatomical variations were also noted on pre-operative CT such as medially bent uncinata process, laterally bent uncinata process, polypoid uncinata, paradoxical middle turbinate and haller cells. After complete pre-operative evaluation MIST was performed. Septoplasty was done in association with MIST In order to get access for nasal endoscope. Various surgical procedures were performed under heading of MIST (figure 6 & table 3).

FIGURE 6 : SURGICAL PROCEDURES PERFORMED (N=60)



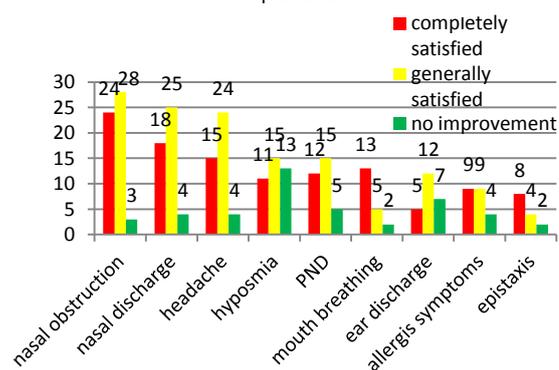
Endoscopic Septoplasty was done in 47(78.33%) of cases which was in association of MIST to get a wide access for nasal endoscopy. Uncinectomy was done in 22(36.7%) of cases unilaterally and 17(28.33%) of cases bilaterally. CB exteriorization was done in 22(36.7%) of cases of which 10(16.67%) were unilateral and 12(20%) were bilateral. Opening of bulla ethmoidalis was done in 11 cases of which 08(13.33%) cases were done unilaterally and 03(5%) bilaterally. Anterior ethmoidectomy was done in 19 cases of which 3(5%) went unilateral

Table 3:-Surgical Procedures Performed (N=60)

PROCEDURE	U/L	%	B/L	%
Endoscopic septoplasty	47	78.33		
Anterior ethmoidectomy	03	05	16	26.7
Uncinectomy	22	36.7	17	28.33
CB exteriorization	10	16.67	12	20
Posterior ethmoidectomy & sphenoidectomy	01	1.67	12	20
Opening of bulla ethmoidalis	08	13.33	03	05
Inferior turbinate submucosal diathermy	04	6.67	03	05
Endoscopic polypectomy	08	13.33	07	11.67
Frontal recess clearance	04	6.67	06	10

anterior ethmoidectomy and 16(26.7%) went bilateral anterior ethmoidectomy. Posterior ethmoidectomy and sphenoidectomy was carried out in 13 patients of which 01(1.67%) under went unilaterally while 12 (20%) cases underwent bilaterally. Inferior turbinate submucosal diathermy was done in 07 patients of which 4(6.67%) underwent unilaterally and 3(5%) underwent bi laterally.

Figure 7:- Post-operative improvement



Endoscopic polypectomy was done in total of 15 patients out of which 8(13.33%) underwent unilaterally and 7(11.67%) underwent bilaterally. Frontal recess clearance was done in 10 patients out of which 4(6.67%) were done unilaterally and 6(10%) were done bilaterally.

After performing MIST, subjective improvement was assessed post-operatively (figure 7 & table 4). Patients were divided into three categories on the basis of post-operative subjective improvement. Patients completely satisfied (CS) after surgery, generally satisfied (GS) after surgery and no improvement (NI) after surgery. Patients which were completely satisfied after surgery with the results (CS)- 39.51%. Patients generally

satisfied with the results after surgery(GS) were 46.04%. And patients who did not improve after surgery were(NI)- 15.1%. So combining CS and GS the overall success rate came to be 85.5%. No major post-operative complication occurred in this study (table 5). 3(5%) cases presented with postoperative echymosis and 2(3.33%) cases presented with subconjunctival haemorrhage. In the less severe group of complications, 6(10%) patients presented with postoperative adhesions. Subconjunctival haemorrhage was seen in 2(3.33%) patients and post operative haemorrhage was also seen in 2(3.33%) of cases.

Table 4:-Post Operative Subjective Improvement

SYMPTO MS	TOTAL NO.	CS	%	GS	%	N I	%	TOTAL L%
Nasal obstruction	55	24	43.63	28	50.9	03	5.4	93.69
Nasal discharge	47	18	38.29	25	53.19	04	8.5	91.48
Epistaxis	14	08	57.14	04	28.5	02	14.2	85.64
Headache	38	15	39.47	21	55.26	04	10.5	94.73
Hyposmia	39	11	31.4	15	38.46	13	33.3	69.86
PND	32	12	37.5	15	46.87	05	15.6	84.37
Mouth breathing	20	13	65	05	25	02	10	90
Ear discharge	24	05	20.8	12	50	07	29.1	70.8
Allergic symptoms	22	09	40.9	09	40.9	04	18.1	82
TOTAL	291	115	39.51	134	46.04	44	15.1	85.55

Table 5:-Complications Encountered During Surgical Procedures

COMPLICATIONS	TOTAL NO.	%
Post op haemorrhage	02	3.33
Csf leak	-	-
Optic injury	-	-
Orbital haematoma	-	-
Echymosis	03	05
Subconjunctival haemorrhage	02	3.33
Restricted eyeball movement	-	-
Septal perforation	04	6.67
Orbital subcutaneous emphysema	-	-
Direct brain injury	-	-
Nasolacrimal duct injury	-	-

Table 6:- Comparison Of Various Anatomical Variants In Ct Scan With Other Studies

Anatomical Variant	Zinerich %	Bolger %	Lloyd %	Calhoun %	Kosling %	Elahi %	Our study
Paradoxical MT	NA	27.1	13.3	12	13.3	19	10.6
Concha Bullosa	34	53.6	24	29	23.6	23	40.6
Septal deviation	28	NA	NA	40	NA	51	90
Agger Nasi Cells	NA	98.5	03	NA	23.6	34	82.9
Haller's Cells	10	45.9	15	NA	23.6	20	12.7

Table 7:- Comparison of Various Mucosal Sinus Abnormalities During CT Scan Study With Other Studies

Study	Maxillary	Anterior ethmoid	Posterior ethmoid	Sphenoid	Frontal
Diament et al	28.8	31.3	NA	7	0
Kennedy & Zinerich	66	78	31	16	34
Hanas et al	24.4	28.4	NA	11	4.8
Glater et al	70	48	NA	NA	NA
Calhoun et al	93	34	NA	19	13
Our study	54.25	60.6	22.4	14.89	22.4

Discussion

Functional endoscopic sinus surgery in past used to involve wide, radical extirpation of sinus wall and content. The current modern endoscopic approach in nasal and sinus surgery i.e. **Minimally Invasive Sinus Technique (MIST)** is based on exact identification of focal disturbances, refined surgical intervention and functional restoration of aeration & drainage by mucociliary clearance. Minimally invasive sinus technique (MIST) is targeted endoscopic intervention introduced by **Reuben C. Setliff in 1994**, with goals originally identical to those reported for FESS, however there are distinct differences². In other words it can be said that

MIST is a systematic reproducible approach to FESS with novice modifications aimed at restoring the normal mucosal anatomy & physiology. In this study the clinical profile of patients with chronic rhinosinusitis was evaluated. We have also attempted to quantify subjective levels of improvement both overall and with regard to specific symptoms MIST and meticulous post-operative care.

Levin HL in his series of 250 patients he reported nasal obstruction in 31.6%, headache in 35.4% and discharge in 51.2% of patients³. In our study we have found that the nasal obstruction is most frequent symptom as it was present in 91.66% of patients followed by nasal discharge 78.3%, hyposmia 65%, headache 63.5% and PND 53%. The reason may be the large group in his study, variations in history taking with climatic variations and individually varying symptomatology.

Benninger et al found 56% of patients undergoing FESS to be skin test positive whereas **Rice et al** reported a 15% prevalence of allergy in patients in patients undergoing FESS. A large number of patients presented with the allergic symptoms in this study also. It constitutes 36.6% i.e. 22 patients. It is showing the increasing trends of allergic problems now days due to environmental pollution and occupational exposures. It is consistent with the overall prevalence rate of allergy in patients of chronic rhinosinusitis.

S.K. Kaluskar noted concha bullosa in 13% of cases⁸, **Zinerich and Kennedy et al** encountered concha bullosa in 54% of cases on CT scanning⁹. In our study it was found that concha bullosa was present in 19(40.4%) cases out of which 11(23.4%) were bilateral and 8(17.02%) were unilateral (TABLE 6).

We compared various mucosal sinus abnormalities during CT scan with other studies. Our study was consistent with other studies which also showed almost same frequency of involvement of different sinuses (TABLE 7).

Catalono PJ, Roffmen E et al published a formal outcome study comparing MIST with FESS^{5,6,7}. In this study the outcome from the MIST was surpassed those compared with FESS. More patients after MIST were improved to a level that was better than the normative symptoms data for the healthy individual & general population. Study also demonstrated the surgical revision rate following MIST was 5.9% compared with an average of 0% following FESS. **Steliff RC et al** in their study used geriatric population undergoing MIST for chronic rhinosinusitis, 84% patients feeling significantly better, 10% somewhat better and 6% unchanged. In this present study subjective improvement in patients undergoing MIST after asking improvement in symptomatology in post-operative follow-up period was done. Patients completely satisfied with the results of surgery were 39.51%, partially satisfied were 46.04% and patients with no improvement were 15.1%.

Frakeinlicz suggested that the complications rate decreases with increasing experience. He reported complication rate of 29% in his first 90 cases he performed, compared with only 2.2% in next 90. **Stammberger and Wolf** reported only two cases of CSF rhinorrhea¹. **Levine** reported that 8.3% patients developed minor complications whereas only 0.7% developed major complications. In our study we had 2(3.3%) cases of postoperative hemorrhage as major complications. No incidence of CSF leak, optic injury or orbital haematoma was noted. 3(5%) patients developed ecchymosis and 2(3.3%) patients had subconjunctival hemorrhage postoperatively. Septal perforation was noted in 1(1.67%) cases. On subsequent follow-up and nasal examination, 6(10%) patients found to develop synechia followed by acute headache & facial pain in 4(6.67%) patients. No incidence of subcutaneous emphysema, direct brain injury or nasolacrimal duct injury was there.

Tables Showing Comparison Result Of Other Studies With Ours

Kennedy et al		
Symptoms improvement	After 1.5 yrs	After 7.8yrs
Over all	68	71
Headache	64	68
Nasal discharge	56	60
Nasal congetion	66	65
Sense of smell	53	52
Recurrent infection	45	60

Steven D. Schaefer et al		Dele H. Rice et al	
Symptoms	No.	Symptoms	No.
Improved	83	Asymptomatic	83
Improved with one episode of sinusitis	10	Moderate improvement	10
Little or no improvement	7	Operation unsuccessful	7

Yehudah Roth et al	
Symptoms	No.
Good excellent	53
Moderate improvement	26
No change	21
Worse	0

Yamagishi et al	
Symptoms	No.
Subjective improvement	70
Objective improvement	80

Conclusion

Chronic Rhino-sinusitis usually affects age group ranging from 10-30 yrs with common mode of presentation being nasal obstruction, nasal discharge, headache, and postnasal discharge.

Pre-operative nasal endoscopy helps in diagnosis of sinonasal pathology by revealing structural details and anatomical variations in nasal cavity to a greater extent there-by gives a clear cut idea of extent of disease prior to surgical intervention. Nasal endoscopy confirms the findings of anterior rhino-scopy.

CT scan accurately defines micro-anatomical locales in and around the osteomeatal unit, and also identifies dangerous anatomical variants like dehiscent optic nerve canal and carotid canal. It

gives the exact extent of sinus disease and acts as anatomical road map prior to surgery.

CT scan is foundation on which surgery should be based. Surgical steps should be pre-planned in relation to CT scan done during least symptomatic period. If the disease encountered during surgery is more extensive than anticipated, do not alter preplanned surgical decision.

Avoid manipulating or interfering with the osteomeatal unit if disease is not evident on CT scan.

Removal of entire uncinate process and anterior ethmoid is too aggressive a procedure for treating limited disease in the osteomeatal area. It can result in the loss of normal nasal mucosa, excessive scarring and iatrogenic frontal recess obstruction. Unnecessary stripping of mucosa leads to scarring which in turn causes of loss of ciliary lining increases the risk of recurrent infections. This can worsen the symptom and patient can become “sinus cripple”. Because MIST does not manipulate the primary maxillary sinus ostium, the latter remains in oblique or horizontal plane, making it less likely to be obscured by lateralized middle turbinate.

Our study shows that **MIST** is a **safe and effective method** of treatment in cases of Chronic Rhino-sinusitis in all age group of patients.

MIST clearly offers a number of advantages.

We can conclude by saying MIST provides a better understanding of sinus pathophysiology and opens the new horizons of treating them with minimal injury to the surrounding normal mucosa.

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