Partial Resection versus Preservation of Middle Turbinate in Surgery for Chronic Rhinosinusitis With - Without Nasal Polyposis

Original Article

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ABSTRACT

Background: The decision between the partial resection and preservation of the middle turbinate has raised considerable debate.

Patients and Methods: This prospective study included thirty randomly selected patients with chronic rhinosiusitis with polyps who underwent surgery. A total 60 sides of nasal cavity were divided into two groups with 30 sides each. Group I comprised 30 sides underwent FESS with partial middle turbinate resection and group II comprised the opposite 30 sides underwent FESS without MTR and each patient acts as his own control. Both groups were compared objectively and subjectively postoperatively at the 1st, 3rd and 6th month postoperatively.

Results: The results showed endoscopic grade 0 mucosa was found more in group I (100%; n = 30) than group II (73.3% n = 22) and the recurrence of nasal polyps was 0.00% (n = 0) in group I compared to recurrence 26.6% (n = 8) in group II. Nasal obstruction was grade 0 in 100% (n =30) sides of group I and grade 0 in 73.3% (n = 22) sides of groupII. Hyposmia improved to normal in group I in 100% n=30 compared to hyposmia in 26.66% n=8 in group II. The 30 (100%) resected sides of group I showed central middle turbinate stump not obscuring frontal recess area with 100% patency of frontal sinus ostia compared to 5 cases 16.7% in group II showing frontal sinus ostium closure . Maxillary sinus antrostomy patency was found patent in 100.00% (n = 30) sides and in group II it was 73.33% (n = 22).

Key Words: Endoscopic sinus surgery, polypsis, resection.

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INTRODUCTION

Respiratory physiology and pathology are strongly dependent on the airflow inside the nasal cavity. Since nasal airflow is heavily affected by the geometry of the flow passage, changes in the anatomical shape of the nasal cavity, due to diseases or surgical treatments, alter the nasal resistance and functions of nose.The middle turbinate is a complex, three-dimensional structure and it has many attachments.It can be divided into three parts, depending on its attachment and orientation in the three-dimensional space[1]. The middle turbinate is regarded as a key landmark in endoscopic sinus surgery, forming the medial boundary of the osteo-meatal complex. This places it at the center of effort to restore and preserve well-functioning Sino-nasal area[2]. It also plays a wide variety of physiologic roles including directing and maintaining laminar airflow, humidifying and warming inspired air and protecting the maxillary and ethmoid cavities from the drying effects of inspired air, which may disrupt muco-ciliary clearance[3].

It also has been shown that olfactory neuroepithelium exists within the superior portions of the middle turbinate. However, this is a relatively small amount of olfactory tissue compared with the entire distribution of surface area available for olfaction,which is also found in the olfactory cleft in the superior nasal cavity on the cribriform plate, upper septum and medial superior turbinate[4].

One of the surgical modifications is the partial middle turbinectomy (MTR). Usually the partial resection is done during endoscopic sinus surgeries (ESS) for the patients with chronic sinusitis with or without polyps and endoscopic endonasal skull base surgeries. There still exist controversies regarding the resection or preservation of the middle turbinate during functional endoscopic sinus surgery[5,6]. Although it is generally accepted by rhinologists that a diseased or flail middle turbinate should be excised, air conditioning, filtration functions, possible loss of olfaction, and emptynose syndrome (ENS) after MTR are of concern[5]. The most important reason for MT preservation is that the turbinate represents a consistent bony landmark in endoscopic sino-nasal and skull base surgery, Forming the medial boundary of the ostio-meatal

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complex (OMC) and the functional drainage pathway of the frontal, maxillary, and anterior ethmoid sinuses[2]. Arguments in favor of middle turbinate resection have included easier endoscopic access, prevention of middle turbinate lateralization and synechia formation, increased maxillary antrostomy patency rates, as well as postoperative inflammatory changes to the middle turbinate itself[5]. Wigand describes resecting the posterior third of the middle turbinate when performing any retrograde spheno-ethmoidectomy[7]. Freedman and Kern described resection of the middle turbinate to within 0.5 cm of the skull base as an integral part of all spheno-ethmoidectomies[8]. The aim of this study was to evaluate the effects of resecting the anteroinferior part of MT on airway patency, crustations and adhesions in the MM, recurrence of nasal polyps, sense of olfaction and frontal sinus drainage pathway.

PATIENTS AND METHODS

Thirty patients shared in this prospective randomized controlled study. The patients are those ones who presented to Otorhinolaryngology Department, Cairo University Hospital with chronic rhinosinusitis with sionasal polyps. The study was conducted within the time interval between June 2018 and April 2020.

All patients included in this study have chronic rhino sinusitis with sinonasalpolyps (Grades 3 and 4 Lund and Kennedy on radiological staging)[9]. Exclusion criteria included patients with Unilateral nasal pathology, history of previous nasal operation and age less than 17 years or more than 50 years old.

A total 60 sides of nasal cavity were divided into two groups with 30 sides each. Group I comprised 30 sides underwent FESS with partial middle turbinate resection (pMTR) and group II comprised the opposite 30 sides underwent FESS without MTR and each patient acts as his own control.Written informedconsent was taken from all patients.Preoperatively, questionnaire to elicit severity of symptoms which are nasal obstruction, headache, nasal discharge, severity of smell[10], endoscopic examination and grading of sinonasal polyps according to Meltzer *et al.*[11] and non-contrast computerised tomographic scan of nose and paranasal sinuses and were categorized according to Lund-Kennedy CT grading systemin all patients were done.

The procedure was done under general anaesthesia. All the cases in the study underwent functional endoscopic sinus surgery (FESS) under general anaesthesia. Each participant will have the middle turbinate resected partially on one side (group 1) and preserved on the other side (group 2). Depending upon the extent of the disease, a routine Messerklinger technique is performed using the intact, medialised middle turbinate as an important landmark. The partial resection of the middle turbinate is usually performed at the end of the operation and only occasionally in the early part of the operation if the access to the osteomeatalcomplex (OMC) is very restricted. An angled scissor is used to make a cut in the anterior end of the middle turbinate in the postero-inferior direction (Figure 1). A second cut is made joining the first from below upwards, thus freeing a small wedge of about one centimetre of the anterior end of the middle turbinate. Bleeding is usually minimal, and could controlled by packing the nose for a few minutes. Occasionally a spurting vessel may need to be cauterized.

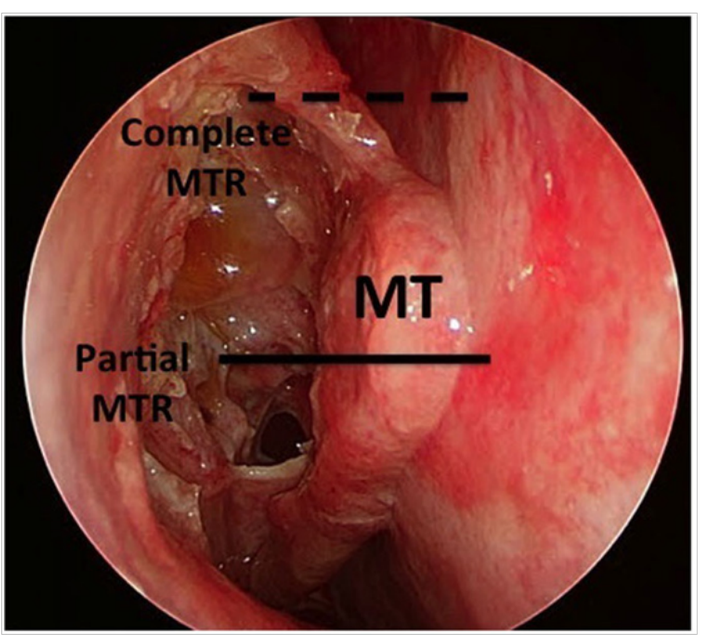

Fig. 1: Illustration of anteroinferior resection of middle turbinate

At each follow up visits at the 1st, 3rd and 6th month postoperatively, the partially resected and preserved middle turbinate, its lateralization, medialization, central position, recurrence of polyposis, patency of maxillary and frontal sinuses and synechiae formation were assessed endoscopically. Subjective improvement was assessed by enquiring about symptoms of nasal obstruction, headache, hyposmia and rhinorrhea. Crustations were scored using Wormald scoring system as following(0= no crustations, 1= few isolated crusts, 2= <50%, 3= >50%)[12]. Both the objective (Endoscopic assessment done at 1st, 3rd and 6th month postoperatively and CT assessment was done at 1st and 6th month postoperatively) and subjective improvements of group I and group II were compared pre and post-operatively. There were no intraoperative complications.

Data were coded and entered using the statistical package for the Social Sciences (SPSS) version 26 (IBM Corp., Armonk, NY, USA). Data was summarized using mean and standard deviation for quantitative variables and frequencies (number of cases) and relative frequencies (percentages) for categorical variables. For comparing categorical data, Chi square ($\chi 2$) test was performed. Exact test was used instead when the expected frequency is less than 5[13]. *P*-values less than 0.05 were considered as statistically significant.

RESULTS

This study included 30 patients, A total 60 sides of nasal cavity were divided into two groups with 30 sides each. Group I comprised 30 sides underwent FESS with partial middle turbinate resection (pMTR) and group II comprised the opposite 30 sides underwent FESS without MTR and each patient acts as his own control.This study included 14 males (46.7%) and 16 females (53.3%). The age ranged between 21 and 50 years. Preoperative symptomatic, endoscopic and radiological assessment data were collected (Tables 1 and 2).

Table 1: Age distribution of the study.

	N	Minimum	Maximum	Mean	Std. Deviation
Age	30	21	50	33.07	8.08

Table 2 : Preoperative symptomatic, endoscopic and radiological assessment

		All patients	
		Count	%
Sex	male	14	46.7%
	female	16	53.3%
Nasal Obstruction (Pre)	grade 3	11	36.7%
	grade 4	19	63.3%
Headache (Pre)	grade 1	7	23.3%
	grade 2	4	13.3%
	grade 3	19	63.3%
Smell (Pre)	hyposmia	30	100.0%
Nasal discharge (Pre)	moderate grade 1	7	23.3%
	heavy grade 2	17	56.7%
	heavy grade 4	6	20.0%
Endoscopic Grading Of SNP (Pre)	Grade 3	17	56.7%
	Grade 4	13	43.3%
Radiological Grading Of SNP (Pre)	Grade 3	5	16.7%
	Grade 4	25	83.3%

Both groups were compared objectively and subjectively postoperatively at the 1st, 3rd and 6th month postoperatively. The results showed endoscopic grade 0 mucosa was found more in group I (100%; n = 30) than group II (73.3% n = 22) and the recurrence of nasal polyposis was 0.00% (n = 0) in group I compared to recurrence 26.6% (n = 8) in group II. Nasal obstruction was grade 0 in 100% (n =30) sides of group I and grade 0 in 73.3% (n = 22) sides of group II. Hyposmia improved to normal in group I in 100% n=30 compared to hyposmia

in 26.66% n=8 in group II. The 30 (100%) resected sides of group I showed central middle turbinate stump not obscuring frontal recess area with 100% patency of frontal sinus ostia compared to 5 cases 16.7% in group II showing frontal sinus ostium closure with lateralized MT (20%; n = 6). Maxillary sinus antrostomy patency was found patent in 100.00% (n = 30) sides and in group II it was 73.33% (n = 22). Crustations were higher in group I during the first three months postoperatively. This study showed that partial resection of middle turbinate lessen the ooportunity of recurrence of disease and resulted in significantly better endoscopic and symptomatic improvements (Table 3).

Table 3: Sixth month postoperative follow up visit.

		Group 1		Group 2		*P* value
		Count	%	Count	%	
Nasal Obstruction (post) 6 mon	grade 0	30	100.0%	22	73.3%	0.005
	grade 2	0	0.0%	6	20.0%	
	grade 3	0	0.0%	2	6.7%	
Headache (post) 6 mon	grade 0	17	56.7%	11	36.7%	0.121
	grade 1	13	43.3%	19	63.3%	
Smell (post) 6 mon	hyposm	0	0.0%	8	26.7%	0.005
	normal	30	100.0%	22	73.3%	
Nasal discharge (post) 6 mon	grade 0	30	100.0%	28	93.3%	0.492
	grade 2	0	0.0%	2	6.7%	
Endoscopic Grading Of SNP (post) 6 mon	Grade 0	30	100.0%	22	73.3%	0.005
	grade 2	0	0.0%	4	13.3%	
	grade 3	0	0.0%	4	13.3%	
Radiological Grading Of SNP (post) 6 mon	grade 0	30	100.0%	22	73.3%	0.005
	grade 2	0	0.0%	4	13.3%	
	grade 3	0	0.0%	3	10.0%	
	grade 4	0	0.0%	1	3.3%	
Crustations (post) 6 mon	grade 0	30	100.0%	30	100.0%	----
Frontal Sinus (Ostium Patency) (post) 6 mon	yes	30	100.0%	25	83.3%	0.052
	no	0	0.0%	5	16.7%	
Maxillary Sinus (Ostium Patency) (post) 6 mon	yes	30	100.0%	22	73.3%	0.005
	no	0	0.0%	8	26.7%	
Maxillary Sinus (Synechiae) (post) 6 mon	yes	0	0.0%	8	26.7%	0.005
	no	30	100.0%	22	73.3%	
Position Of Middle Turbinate Stump (post) 6 mon	Medialized	0	0.0%	5	16.7%	< 0.001
	Lateralized	0	0.0%	6	20.0%	
	Central	30	100.0%	19	63.3%	

DISCUSSION

Anterior part of middle turbinate has been found to be an important area in secretion of vasoactive neuropeptides which predispose mucosal edema and polyp formation. The unmyelinated sensory fibres in nasal mucosa secretes neuropeptides, calcitonin gene related peptides, substance P and neurokinin A. Mechanical or contact stimulation of anterior part of middle turbinate mucosa provokes secretion of these substances[14]. Patients with chronic non allergic rhinosinusitis have a two fold increase in calcitonin gene related peptide in their middle turbinate mucosa[15].

Partial MTR facilitates drug delivery to frontal and sphenoid sinuses postoperatively, thus decreasing formation of polypoidal mucosa[16]. Middle turbinate acts as important anatomical landmark in functional endoscopic sinus surgery. Partial antero-inferior resection of middle turbinate leaves behind the bulk of middle turbinate as useful anatomical landmark[17].

The recurrence of nasal polyposis which is a commonly encountered scenario in clinical practice may occur up to 40–90% of cases[18, 19]. It has been described that the interval to revision surgery is longer in patients who underwent FESS with MTR[18]. In the current study, endoscopic grade 0 mucosa was found more in group I (100%; n = 30) than group II (73.3% n = 22) (*P* value = 0.005) and the recurrence of nasal polyposis was 0.00% (n = 0) in group I compared to recurrence 26.6% (n = 8) in group II (*P* value = 0.005). This may be due to better delivery of saline irrigation and nebulized steroids in the nasal side with partially resected middle turbinate compared to the preserved one during the follow-up period.

Postoperatively at the end of 6 months follow up, nasal obstruction was grade 0 in 100% (n =30) sides of group I and grade 0 in 73.3% (n = 22) sides of group II. None of the side of neither group I nor group II had grade 4 nasal obstruction. Cook *et al.* showed improvement in nasal airflow (*P* value = 0.001) and significant decrease in nasal resistance (*P* value = 0.001) in resected middle turbinate group[20]. The current study showed near similar improvement of nasal obstruction in both the groups but it was more evident in group I than group II (*P* = 0.005). Gulati *et al* showed that 40 patients of chronic sinusitis were selected and divided into 2 groups, group I undergoing FESS with middle turbinate preservation and group II undergoing FESS along with middle turbinate resection. Final results were recorded 6 months after the operative procedure. 50% patients had relief in nasal obstruction in group I as compared to 88% in group II. Postoperative synechiae formation was seen in five patients in group I and in one patient in group II[21]. Postoperatively, hyposmia improved to normal in group I in 100% n=30 compared to hyposmia in 26.66% n=8 in group II. Resection of antero-inferior portion of middle turbinate leaving superior aspect unaffected may improve olfactory score due to better airflow to olfactory cleft. Soler *et al.* showed the volume of the space between the midportion of the septum and the middle turbinate correlated strongly with olfactory acuity as measured by Odorant Confusion Matrix and smell identification test. Resection of the middle turbinate, especially in instances of severe inflammation or polyps, might increase airflow to the olfactory cleft, allowing odorant molecules access to the olfactory epithelium[22]. The fact that patients undergoing MT resection had greater improvement in olfaction is quite interesting. Early teachings warned of possible olfactory loss related to middle turbinate resection. The premise of this argument is that olfactory epithelium may be found in the superior-most aspects of the middle turbinate[23].

However, Friedman followed olfactory scores preoperatively and 8 weeks postoperatively showing no difference in scores based on whether the middle turbinate was resected or preserved[24].

Leopold concluded that there is a relationship between changes in the structure of the upper nasal cavity and changes in olfactory ability, two regions were found to be important factors in accounting for olfactory function (a region 10 to 15 mm below the cribriform plate and medial to the middle turbinate accounts for 52% of the variability of odorant confusion matrix responses and another region which is high in nasal cavity anterior to cribriform plate and this region its olfactory ability decreases as its volume increases) and lastly it is possible to improve olfactory dysfunction by enlarging spaces medial to the lower part of middle turbinate[25]. Alam *et al.* showed MTR increases nasal airflow while decreasing the nasal resistance. Overall, olfactory flux increased for high sorptive (phenylethyl alcohol) and medium sorpitve (l-carvone) odorants. However, the significant variation observed in one of Alam models suggests that the effects of MTR on the nasal airflow and the resultant olfaction can vary between individuals based on individual anatomic differences[26]. Lee *et al*. showed that removal of the antero inferior part of middle turbinate while preserving posterior margin will not alter airflow characteristics extensively[27].

The symptomatic improvement regarding nasal obstruction and smell was more in group I in comparison with group II with at the end of 6 months follow up and *P* value = 0.005 regarding nasal obstruction and smell. Marchioni *et al*. also showed improved quality of life among both the resected and preserved middle turbinate group and the *P* value is < 0.001[28]. It has been described that there is 10% chance frontal sinusitis following PMT resection[29]. In this study, the 30 (100%) resected sides of group I showed central middle turbinate stump not obscuring frontal recess area with 100% patency of frontal sinus ostia compared to 5 cases 16.7% in group II showing frontal sinus ostium closure with lateralized MT (20%; n = 6). Adhesion formation occurs when two raw mucosal surfaces approximate with each other. The space of frontal recess widened and it is unlikely to form adhesion following PMT resection. Thus frontal sinusitis following FESS is a consequence of disease process of inflammatory nasal mucosa, not due to middle turbinate resection. Pinther *et al.* showed a 0% incidence of complete frontal stenosis during the study period in both the partial and complete MTR groups[30]. Note that it was still possible for patients to have partial frontal outflow tract stenosis, but as long as the scarring did not cause complete frontal stenosis, it was not reported. Also note that meticulous postoperative debridement of the frontal outflow tracts was performed under angled endoscopy in all patients to prevent complete stenosis. The frontal outflow tracts are at risk for stenosis postoperatively either from ostial stenosis or MT lateralization, and sinus debridements have been shown to decrease risk of sinus stenosis and MT lateralization[31]. In group I maxillary sinus antrostomy patency was found patent in 100.00% (n = 30) sides and in group II it was 73.33% (n = 22). These findings were comparable to Davis *et al.* and Biedlingmaier *et al.* who reported 92–96% chance of maxillary antrostomy patency with resection of middle turbinate[17, 32]. Similarly, Scangas *et al.* also

concluded improved sinonasal passages with resection of MT and both frontal and middle meatalantrostomy patency also improves with PMT resection[33]. Kaluskar showed that simple wedge resection of the anterior part of the middle turbinate achieves decreased rate of synechia formations and closure of the antrostomy and recommend its use as an adjunct to the technique of FESS and none of the patients suffered any post-operative olfactory dysfunction or excessive crusting as a result of this procedure[34]. Both the groups showed symptomatic improvement of headache postoperatively without any statistical significance.

All group I showed no rhinorrhoea compared to 6.7% n= 2 in group II respectively (*P* value = 0.492). Crustations were higher in group I when compared to group II during the first three months postoperatively respectively.

In contrary to this current study Ahmed and Osman showed that no statistically significant differences were observed in the presence of crusts, adhesions, polyp recurrence, smell affection, frontal sinus drainage pathway obstruction, or overall nasal patency between the findings on the two operated sides. The operative time was significantly shorter for the group with MTR and concluded that MTR carries no adverse effects and can be carried out safely in endoscopic sinus surgery[35]. Also Hudon *et al.* showed that no sustained objective endoscopic benefit of routine middle turbinectomy, at least within the first six postoperative months, in patients undergoing primary ESS for CRS with polyposis[36].

In the current study, there were no significant incidences of haemorrhage, CSF leak or orbital injury in either group. Choby *et al.* had also shown no significant difference in the incidence of complications like epistaxis requiring return to operation theatre, orbital haematoma or CSF rhinorrhoea in either group[37].

CONCLUSION

This study showed that partial resection of middle turbinate decreased the opportunity of recurrence of disease and resulted in significantly better symptomatic improvements. Therefore, a larger sample considering associated disease processes and a prolonged follow-up may be considered for further evaluation of efficacy of pMTR

CONFLICT OF INTEREST

There are no conflicts of interest.

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