

Outcomes of middle turbinate-septal adhesion technique and trans-septal middle turbinate suture technique to prevent middle turbinate lateralization: a comparative study

Muaid I. Aziz Baban

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq, muaident@gmail.com

Hiwa A. Rawandizi

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq

Hozan F. Ali

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq

Sahar J. Hadi

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq

Shkar N. Mohammed

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq

Follow this and additional works at: <https://pajr.researchcommons.org/journal>



Part of the [Oral and Maxillofacial Surgery Commons](#), [Otolaryngology Commons](#), and the [Otorhinolaryngologic Diseases Commons](#)

Recommended Citation

Baban M, Rawandizi H, Ali H, et al. Outcomes of middle turbinate-septal adhesion technique and trans-septal middle turbinate suture technique to prevent middle turbinate lateralization: a comparative study. *Pan Arab J. Rhinol.* 2023; 2022; 12 : 6-13.

Available at: <https://pajr.researchcommons.org/journal/vol12/iss1/3> DOI: <https://doi.org/10.58595/2090-7559.1000>

This Original Study is brought to you for free and open access by Pan Arab Journal of Rhinology (PAJR). It has been accepted for inclusion in Pan Arab Journal of Rhinology by an authorized editor of Pan Arab Journal of Rhinology (PAJR).

ARTICLE

Outcomes of Middle Turbinate-Septal Adhesion Technique and Trans-septal Middle Turbinate Suture Technique to Prevent Middle Turbinate Lateralization: A Comparative Study

Muaid I. Aziz Baban*, Hiwa A. Rawandizi, Hozan F. Ali,
Sahar J. Hadi, Shkar N. Mohammed

Unit of Otorhinolaryngology–Head & Neck Surgery, Department of Surgery, University of Sulaimani, College of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, Iraq

Abstract

Background: Middle turbinate lateralization (MTL) is the most common undesirable sequela after functional endoscopic sinus surgery (FESS), which can result in recurrent sinusitis.

Objectives: To examine the efficacy and outcomes of different techniques to prevent failure of the primary surgery.

Patients and methods: Eighty patients who presented with chronic rhinosinusitis listed for FESS were enrolled in this study. Patients were divided randomly into two groups, with 40 patients each. In group A, middle turbinate (MT) was stabilized by adhesion technique, and in group B, MT was stabilized via suture technique. A comparison of the effectiveness and the outcomes of both techniques was done by assessing the MT position and synechiae formation, which is considered a primary outcome. Secondary and tertiary outcomes were assessed through Lund–Kennedy Score and Lund–Mackay, and Sino-nasal Outcome Test-8 and Sniffin Sticks identification test scores, respectively.

Results: Although a higher incidence of MTL and synechiae was detected in the adhesion group after 1, 3, and 6 months of follow-up, there was no significant difference between both groups, with *P* values of 0.74, 0.11, and 0.089, respectively. We found at the end of the sixth month postoperatively, a noticeable improvement in Lund–Kennedy Score, Lund and Mackay Score, Sino-nasal Outcome Test-8, and Sniffin Sticks identification test scores in both groups, with *P* values of 0.0004/0.0002, 0.001, 0.000, and 0.0002/0.0001, respectively, which are highly statistically significant differences, but there was no significant difference among both groups, with a *P* value of 0.24.

Conclusion: The primary goal must be considered to be prevention of MTL, and the medialization techniques should not be carried out routinely in FESS.

Keywords: Basal lamina, Lateralized middle turbinate, Middle turbinate, Middle turbinate-septal adhesion technique, Synechiae, Trans-septal middle turbinate suturing technique

1. Introduction

In functional endoscopic sinus surgery (FESS), the stability and integrity of the middle turbinate (MT) have fundamental roles in the prevention of the recurrence of the disease [1]. The most common undesirable sequelae after endoscopic sinus

surgery, which are against the original concept of FESS, are the middle turbinate lateralization (MTL) and synechiae formation with the lateral nasal wall, which may enhance the ostiomeatal complex (OMC) obstruction, recurrence of the disease, and then ultimately will require additional surgery. During the course of the FESS, care should be directed toward

Received 26 January 2022; accepted 10 April 2022.
Available online 16 January 2023

* Corresponding author at: Unit of Otorhinolaryngology, Department of Surgery, University of Sulaimani, School of Medicine, Sulaymaniyah Teaching Hospital, Sulaymaniyah, Kurdistan Region, 46001, Iraq.
E-mail address: muaident@gmail.com (M.I. Aziz Baban).

<https://doi.org/10.58595/2090-7559.1000>

2090-7559/© 2023 Pan Arab Rhinology Society. This is an open access article under the CC-BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

the MT; the vertical and the posterior horizontal attachments of the MT at the basal lamina should be preserved to prevent its destabilization and lateralization to ensure a good postoperative result and to prevent synechiae formation by avoiding the instrumentation of the lateral aspect of the MT [2–5].

Several techniques have been advocated to prevent MTL. Shikani [6] proposed a middle meatal antrostomy stent in the maxillary natural ostium for 2 weeks to keep the OMC patent. Thornton [7] suggested suturing of the MT and septum. Bolger et al. [8] described planned medial synechiae by using a sickle knife to abrade the MT and septum and stabilize the lateral side of the MT with packing. Later on, Friedman et al. [9] used a microdebrider instead of a sickle knife. MT resection is also a viable surgical option with published benefits (if done properly with a carefully selected subgroup of patients). When the MT is involved in the disease process, Soler et al. [10] mentioned the effectiveness of the partial resection of the anterior part of the MT in preventing the MTL and obstruction of frontal recess. Although the aforementioned technique noted the efficacy in re-stabilizing of the MT, strong evidence reporting the benefit of these techniques in long-term outcomes still does not exist.

However, appropriate management of the MT remains controversial [11]. The current study examines two different techniques that have been chosen for stabilization of the floppy MT to ensure the postoperative patency of the middle meatus and OMC (the controlled scar or adhesion MT-septum and MT trans-septal suturing techniques) [12,13], and comparisons between their efficacy and clinical outcomes have been done.

2. Patients and methods

A prospective comparative case series study was conducted at the Department of Otolaryngology, Head and Neck Surgery (Sulaymaniyah Teaching Hospital, College of Medicine, University of Sulaymaniyah, Kurdistan Region, Iraq), from January 2015 to January 2018. The study was approved by the University's Ethical Committee before patient enrollment.

A total of 80 patients presented with refractory or reluctant chronic rhinosinusitis, which was confirmed clinically and radiologically, and were listed for primary FESS and developed unstabilized MT on both sides. They were included in the current study after obtaining informed consent. Exclusion criteria were as follows: stabilized MT during primary FESS; unilateral or single sinus chronic

inflammatory disease; simultaneous performed inferior turbinate surgery; septoplasty; sinonasal benign and malignant tumor surgeries; patients with a history of previous conventional or FESS with a resected MT; and comorbidities like allergies, aspirin intolerance, and asthma. Randomization was performed before the initiation of data collection and FESS, by means of a coin toss, and the patients were divided into two groups: group A included 40 patients who underwent MT-septal adhesion technique, and group B included 40 patients who underwent trans-septal MT suturing technique. To determine the most valuable medialization maneuver, a comparison of the effectiveness and the outcomes of both techniques was done through the following:

- (1) Assessing the MT positioning and synechiae formation between the MT and lateral nasal wall at the end of the 1, 3, and 6 months, considered as the primary outcome.
- (2) Examining the preoperative and postoperative endoscopic appearances of the patients' sino-nasal cavity at the end of the 1, 3, and 6 months. The endoscopic findings were graded using the Lund–Kennedy Score system (LKS) [14,15], which was considered as the secondary outcome. The findings included edema, discharge, and polyps; each one is designated as follows: edema (absent = 0, mild–moderate = 1, or polypoid degeneration = 2), discharge (absent = 0, hyaline = 1 or thick, and/or mucopurulent = 2), and presence of polyps (absent = 0, limited to the middle meatus = 1, or extended to the nasal cavity = 2). The assessment was performed bilaterally, with the total points corresponding to the sum of values obtained in both sides with a possible total score of 12.
- (3) Preoperative and 6-month postoperative radiological scoring of sinuses as proposed by Lund and Mackay Score (LMS) using computed tomography scan images with a three-dimensional view, where 0 = no opacification, 1 = partial opacification, 2 = complete opacification, whereas 0 = not obstructed and 2 = obstructed for OMC. The total score is 12 for each side [16].
- (4) Examining the postoperative symptom improvement based on abbreviated Sino-nasal Outcome Test (SNOT-8) [17,18], which was recorded as the tertiary outcome. SNOT-8 score was developed from SNOT-22 and enclosed only the questions that focused specifically on sino-nasal function and omitted the overall quality of life queries. A total of eight questions were

asked as follows: need to blow nose, runny nose, nasal obstruction, loss sense of smell, cough, postnasal discharge, thick nasal discharge, and facial pain/pressure. A total possible score of 40 can be recorded according to the degree of the problem. Each symptom was categorized as follows: none, mild, very mild, moderate, severe, and as bad as possible.

- (5) In addition to olfactory function included in the preoperative and postoperative symptoms in SNOT-8 assessment, further objective baseline olfactory function assessment was performed for both groups by applying a Sniffin Sticks identification test (SIT) kit with a validated 16-pen Sniffin questionnaire (Burghart; Wedel, Pinneberg, Schleswig-Holstein, Germany) [19]. The test was performed for right and left nostrils in both groups. The SIT scores range from 0 to 16, and the normative values are 11–15; scores 8–11 represent hyposmia and scores less than 8 are considered anosmia.
- (6) Preoperative baseline (clinical and radiological) assessment of the disease severity in both groups has been done through collection and comparison of LKS, LMS, SNOT-8, and SIT scores.

The sensitivity analysis and power calculation illustrated that a sample size of 80 patients would provide the ability to detect significant differences in the means of scores between the turbinate-septal adhesion and the turbinate-septal suture groups. Statistical analysis was performed using SPSS (Chicago, Illinois 60606-6307, U.S.A.), version 25, for Windows. The difference between the two groups was measured using the Student *t* test. A *P* value less than or equal to 0.05 was considered statistically significant and *P* value less than 0.0001 was statistically highly significant.

2.1. Surgical technique

Whenever the stability of the MT is noticeably affected, especially when the MT is seen folded laterally by itself at the end of the surgery and to lesser degree if pushed laterally not returning back to its original or paramedian position, the medialization technique will be considered for the patient and included in intended group of the study.

In the first group, the ‘adhesion technique,’ the mucosa of the anteromedial end of the MT, just posterior to the caudal edge of the MT, and the opposing septal mucosa were gently abraded with a 4-mm straight microdebrider, resulting in a

denuded area on both surfaces. A merocel sponge was kept in the middle meatus on each side up to 48 h initially. Then suctioning of the middle meatus was done for clot and debris, and a small merocel sponge for an additional 7 days was inserted in the middle meatus to keep it opened and promote controlled synechiae formation between the MT and septum, as shown in Fig. 1.

In the second group, the ‘suture technique,’ a 4-0 polyglactin-coated suture (Vicryl), with a curved needle, 20-mm length, was used. A knot was made extracorporeally at the end of the thread, and then the needle was initially passed from lateral to the medial surface of the MT of either side, traversing the nasal septum, and then trajectory was carried through the contralateral MT and back through the septum and the first MT. On occasion, the endoscope was used to secure the MT while the needle was being passed through. The needle was retrieved and passed back through the septum anterior to the head of the MT; once the needle reached the anterior part of the septum, the suture was tied and a knot was made, as shown in Fig. 1.

Harmonious follow-up was done with regular visits, and postoperative measures were applied to the patients in both groups, which included oral antibiotic clarithromycin 500 mg once daily for 1 month, nasal douching with normal saline 0.9% two to four times daily for 6 weeks, and local application of steroids (mometasone nasal spray) for 3 months. Throughout all visits in the first month (1, 2, and 4 weeks), third, and sixth months, endoscopic examination with cleaning of the sinonasal cavity of debris and clots and removal of late undissolved stiches was carried out with the assessment of stability of the MT, synechiae formation, and the olfaction function. Lysis of the synechiae and insertion of the merocele in the middle meatus were tried to prevent lateralization whenever detected.

3. Results

Regarding the overall patient population, there were 42 (52.5%) males and 38 (47.5%) females, ranging in age between 14 and 69 years, with a mean \pm SD age of 39.3 ± 11.5 years. The most common age group in this study was 31–40 years. The preoperative clinical finding was tested in both groups, and a minimal difference was noted, especially in LMS and SIT mean scores (7.5 vs. 10 and 9.6 vs. 12.25), with a *P* value of 0.39, as shown in Fig. 2.

Lateralization and synechiae rates of 80 sides in each group were examined and compared after 1, 3, and 6 months postoperatively. Although a higher

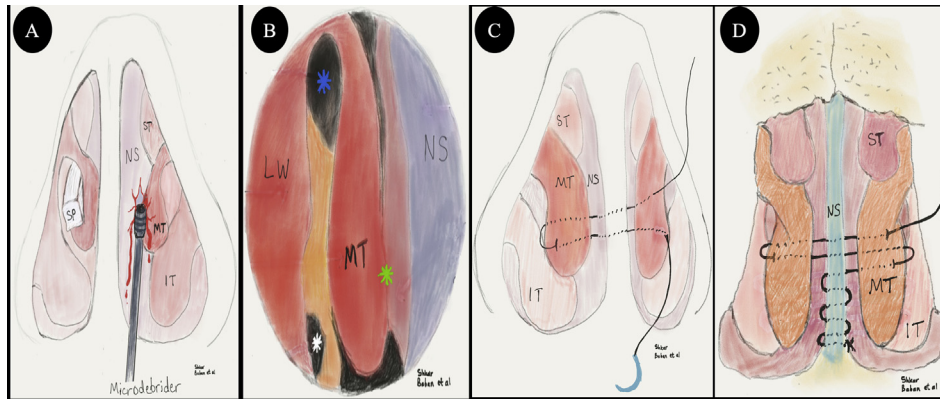


Fig. 1. Middle turbinate-septal adhesion (a, b) and trans-septal middle turbinate suture (c, d) techniques. (a) Basal intranasal endoscopic view shows abrasion of the septum (NS) and medial wall of the middle turbinate (MT) with microdebrider on the left side of the nasal cavity. (SP – splint). Merocele sponge inserted as splint in middle meatus after performing the mucosal abrasion on the other side to control the adhesion technique (IT – inferior turbinate and ST – superior turbinate). (b) Endoscopic view illustrates the adhesion is settled between the nasal septum (NS) and the medial wall of the middle turbinate (MT) and denoted by green *. Middle meatal antrostomy and frontal recess are marked by white and blue *, respectively (LW – lateral nasal wall). (c) Basal intranasal endoscopic view shows the needle of the suture passed through the left middle turbinate, the nasal septum, and contralateral middle turbinate (MT), and back through the nasal septum (NS) and MT on the left nasal cavity. (IT – inferior turbinate and ST – superior turbinate). (d) Axial view of the nasal cavity illustrates the suture quilting the nasal septum (NS) and the thread knotted at the anterior end of the septum on the left side (IT – inferior turbinate, MT – middle turbinate, and ST – superior turbinate).

incidence of the lateralized MT and synechiae was detected in the adhesion group after 1, 3, and 6 months of the surgery, with a rate of 4/80, 6/80, and 8/80 versus 3/80, 4/80, and 5/80, and 6/80, 6/80, and 6/80 versus 4/80, 1/80, and 1/80, respectively, there was no significant difference between both groups after 1, 3, and 6 months after the FESS, with *P* values

of 0.74, 0.11, and 0.089, respectively, as shown in Table 1 and Fig. 3.

By using two-sided independent sample *t* test (SPSS, 25 version), although a significant improvement was found in the LKS, LMS, SNOT-8, and SIT for both groups at the end of the sixth month of the follow-up, with a *P* value of 0.0004/0.0002, 0.001,

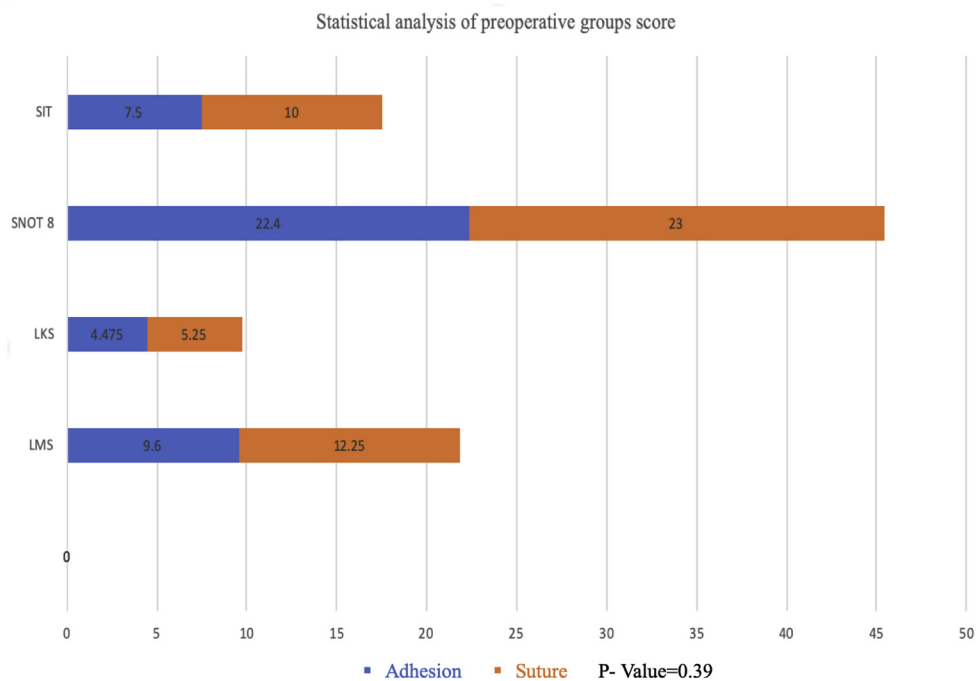


Fig. 2. The statistical analysis of the preoperative LKS, LMS, SNOT-8, and SIT scores in both adhesion and suture technique groups. LKS, Lund–Kennedy Score; LMS, Lund and Mackay Score; SIT, Sniffin Sticks identification test; SNOT, Sino-nasal Outcome Test.

Table 1. Data of preoperative and postoperative subjective and objective test scores in both groups (40 patients, 80 sides) (n, %, right/left sides) in each group.

	Adhesion				Suture			
	Preoperative	1 month	3 months	6 months	Preoperative	1 month	3 months	6 months
MT status								
Lateralized	—	4 (1/3) (5)	6 (4/2) (7.5)	8 (3/5) (10)	—	3 (1/2) (2.7)	4 (3/1) (5)	5 (2/3) (6.25)
Synechia	—	6 (3/3) (6.5)	6 (4/2) (7.5)	6 (2/4) (7.5)	—	4 (2/2) (5)	1 (1/0) (1.2)	1 (0/1) (1.25)
Not lateralized	—	70 (36/34) (89.5)	68 (32/36) (85)	66 (35/31) (82.5)	—	73 (37/36) (92.2)	75 (36/39) (93.7)	74 (38/36) (92.5)
LKS	4.475	5.50	4.075	3.725	5.25	6.13	3.38	3.21
LMS	9.6	—	—	6.1	12.25	—	—	10.58
SNOT-8	22.4	—	—	2.85	23:00	—	—	3.75
SIT	7.5 (8/7)	5 (6/4)	9.5 (9/10)	12.5 (12/13)	10 (9/11)	8.5 (8/9)	12 (11/13)	13.5 (11/14)

The preoperative and postoperative (1, 3, and 6 months) subjective and objective tests score in both adhesion and suturing technique groups.

LKS, Lund–Kennedy Score; LMS, Lund and Mackay Score; SIT, Sniffin Sticks identification test; SNOT, Sino-nasal Outcome Test.

0.0000, and 0.0002/0.0001, respectively, there was no significant difference in all scores between the two groups after 1, 3, and 6 months postoperatively, with a P value of 0.24, as shown in Fig. 4.

Laterality throughout the recorded scores of MT status, LKS, LMS, and SIT was tested. Uneven distribution within both sides and groups was noted, with a nonsignificant P value, as shown in Tables 1 and 2.

4. Discussion

MTL is a comparatively common finding during and after FESS. This raises a clinical question related to this phenomenon to contemplate whether

it as a complication or an incidental harmless sequela? A plethora of previous articles delineate that MTL encompasses a basic role within the worse outcome and recurrence of the sinus mucosal disease [2,20–23].

MTL can be evident even within the most skilled hands for unknown surgical intraoperative events. It is typically elucidated in several mechanisms. Heavy instrumentation of lateral wall of the MT as a result of excessive scraping or shaving results in a raw area in contact with the lateral wall and will end in adhesion and lateralization. Although better visualization of the surgical field might have the mobilization of the MT, this can contribute to instability and freely (floppy) moving MT, which can

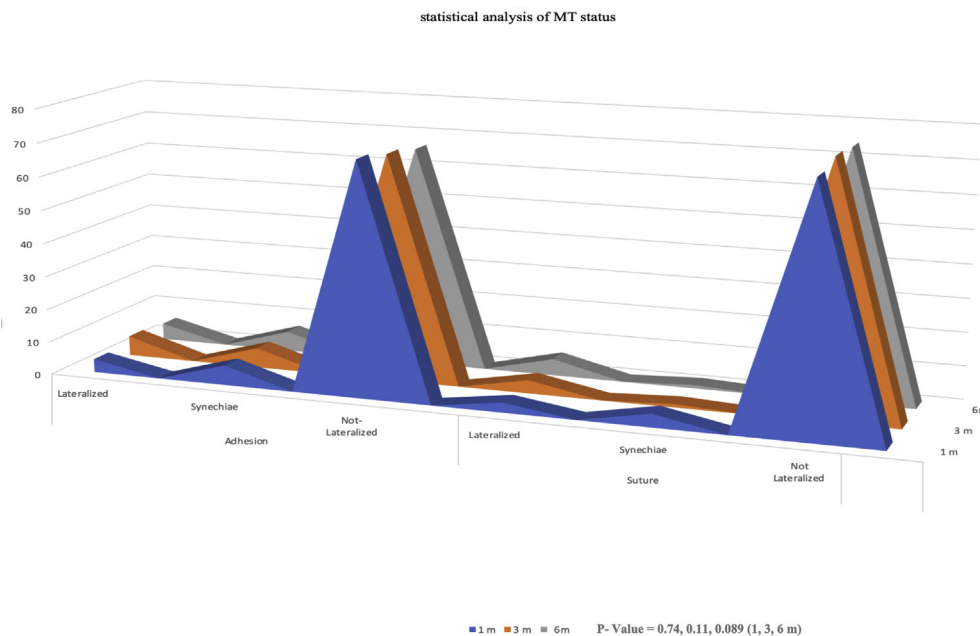


Fig. 3. The statistical analysis of the postoperative middle turbinate status at 1, 3, and 6 months.

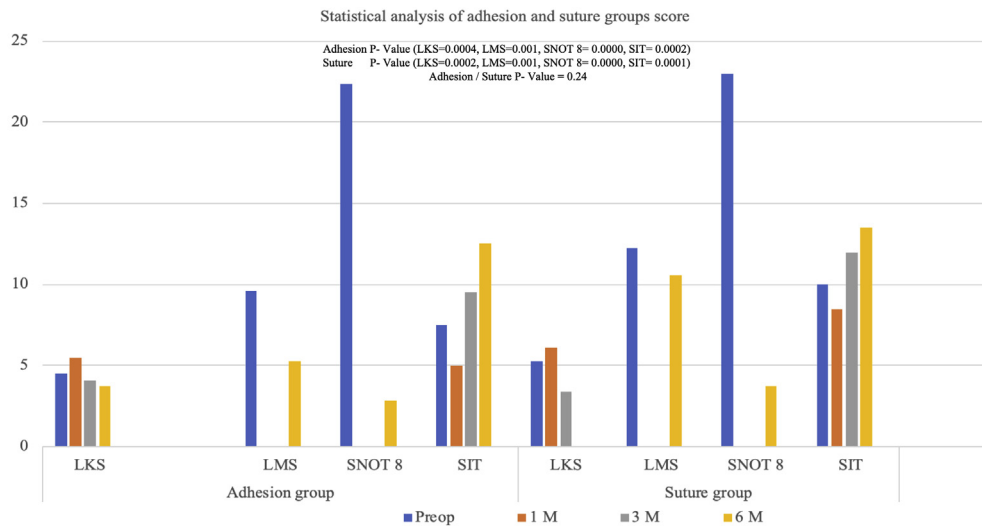


Fig. 4. The statistical analysis of the preoperative and postoperative LKS, LMS, SNOT-8, and SIT scores at 1, 3, and 6 months in both adhesion and suture technique groups. LKS, Lund–Kennedy Score; LMS, Lund and Mackay Score; SIT, Sniffin Sticks identification test; SNOT, Sino-nasal Outcome Test.

increase the possibility of synechiae formation with the lateral wall and MTL ensues. The potential sequela of MTL and also the synechiae formation cause sinus drainage pathway obstruction, which might result in recurrent sinusitis and sometimes necessitate revision sinus surgery.

Bassiouni et al. [24], noted in their article, ‘the inflammatory load hypothesis in refractory CRS,’ that the postoperative healing process might be affected by significant MTL through prevention of adequate penetration of topical steroids into the middle meatus cavity, which results in a persistent inflammatory process, accelerating the remodeling, fibrosis, and scar formation; this will eventually end in sinus ostium stenosis.

Although many techniques have tried to prevent MTL in the past few decades, till now no definite preferable method has been considered. For that reason, further articles are needed to identify the

best method of preventing MTL. Even though Bolger et al. [8] in their series of 10 years of experience used a controlled synechiae technique, they reported it as a safe and highly effective method in the prevention of MTL, and it is supported by Friedman et al. [9] with a success rate in 88%. A double concern is raised regarding this technique due to the memory effect of the MT to re-lateralize again, especially if it is destabilized significantly during the surgery or already congenitally present. Bolger et al. [8] solved this possibility by inserting a stent into the middle meatus; for significant instability, long-duration (10–14 days) stenting with a merocel cover with a finger cot was chosen. If shorter stenting time was elected (especially when there is a mild instability), a weekly visit for assessment of the turbinate position should be done. Whenever the turbinate begins to lateralize, re-creating mucosal abrasion and inserting gelfoam stent for 10–14 days may be needed to create effectively controlled synechiae. Although we follow these considerations in our cases, re-lateralization was noted in this series, especially in the adhesion group in comparison with the suture technique group, where synechiae seen at the first month postoperatively were 6/80 versus 4/80, which increased the incidence of the MTL from 4/80 to 8/80 and 3/80 to 5/80 in both groups, respectively. The current results regarding the efficacy of the controlled synechiae technique to prevent MTL coincide with the reports of Bolger et al. [8] and Friedman et al. [9], where 82.5% of the patients (66/80 sides) reported effectiveness of the technique after 6 months of follow-up, and 17.5% of the

Table 2. Statistical analysis of laterality in both adhesion and suture groups 6 months postoperatively.

Laterality	Adhesion P value	Suture P value
MT status		
Lateralized MT	0.31	0.5
Synechiae	0.5	0
Not lateralized	0.37	0.5
LKS	0.44	0.46
LMS	0.35	0.43
SNOT-8	—	—
SIT	0.383	0.541

The statistical analysis of laterality in both adhesion and suture groups at 6 months postoperatively.

LKS, Lund–Kennedy Score; LMS, Lund and Mackay Score; SIT, Sniffin Sticks identification test; SNOT, Sino-nasal Outcome Test.

patients ranged between noticeable MTL and just synechia at the anterior part of the MT.

Bolger et al. [8] described a suturing technique in their article and showed it as more traumatic than other techniques, which does not coincide with several other authors' reports, which state suturing technique to have a high success rate and it is worthy to consider it to prevent MTL. This discrepancy guides us to the current study, to stress on any valuable variances between both techniques, considering the technical and clinical outcomes of both groups. Suture medialization technique is described by many authors as the most definitive method to prevent MTL. Such findings found in the studies of Thornton [7] have described stabilization of the MT with a turbinate trans-septal suture in 31 patients (60 operated sides). Only one patient was noted to have lateralization of the MT on one side that necessitated further surgery. Furthermore, a study by Marple [25] included 60 patients who were divided into two groups: group A (suturing technique) included 24 patients in whom only one synechia was noted, and group B included 36 patients (no medialization technique) in whom five synechia were reported. Hewitt and Orlandi [26] and Hana and Killy [27] examined the efficacy of the suture technique to abolish MTL, and the success rates were 90 and 98.2%, respectively. Bassiouni et al. [28] and Chen et al. [28] examined the effects of MT suturing technique and showed no significant difference with other techniques in reducing the rate of MTL. However, the first study was limited by nonrandomization, whereas in the second study, a comparison between the two groups of 60 patients each was made, where absorbable splint was used for group A and suture medialization was used for group B. MTL and synechia were significantly higher in group A than those in group B after 3 months of surgery (19 of 120 sides vs. six of 120 sides; $P < 0.01$, and 13 of 120 sides vs. four of 120 sides; $P = 0.023$, respectively). Although the present results are partially in harmony with the aforementioned results, our data showed a significant efficacy of the suture medialization technique in 92.5% (only 5/80 sides with LMT and 1/80 with synechia), which was higher than adhesion group with 82.5% (8/80 with MTL, 6/80 synechia); this difference was not statistically significant, with a P value of 0.089, as shown in Fig. 3.

The present study showed both techniques (adhesion and suturing) were highly effective in abolishing MTL at the end of first, third, and sixth months of postoperative follow-up, with a minimal preference raised toward suturing technique, which was statistically nonsignificant, with P values of 0.74,

0.11, and 0.089, respectively. Secondary and tertiary outcomes were tested using LKS, LMS, SNOT-8, and SIT. Valuable improvements in the sinonasal mucosal healing process and postoperative symptoms after the first month were noticed, and it was much better at the end of the third and sixth months in both groups, with no significant variance between both techniques after 6 months of follow-up, with a P value of 0.24, as shown in Fig. 4. Olfaction has been shown to affect the quality of life, and preservation of this function after FESS is critical and worthy. Although previous studies evaluating the effect medialization techniques on olfaction showed either improvement or no change in the sense of smell after FESS, both adhesion and suturing techniques have been criticized for their likely effects on olfaction [29]. In controlled adhesion technique, a double concern has been raised from excessive scarring between the MT and the septum which could prevent the access of the odorant to the olfactory area in addition to possibility of the septal perforation. Bolger et al. [8] and Friedman et al. [9] confirmed that the study population's sense of smell either improved or did not change in this technique. They explained that fortunately the scar will become quite thin within 2–3 months, hence does not need to be lysed; therefore, olfactory hypofunction will not be affected. On the contrary, in the suturing technique, further to, it is more difficult and time consuming, which may lead to further medialization of the turbinate and could have more effect on olfaction for at least till the suturing materials are absorbed. Smell sensation was not only preserved in the patients in the current study but also actually showed an improvement from a preoperative SIT score of 7.5 and 10 to 6-month postoperative score of 12.5 and 13.5, with a P value of 0.0002 and 0.0001 for both controlled adhesion and suture technique, respectively, as shown in Table 1 and Fig. 4.

In the current study, no remarkable complications or comorbidities were noted and the present authors are pleased with both techniques. In the suturing technique, although suture material was absorbable, it increased the mucous crust accumulation on the knotted part. A regular debridement during the postoperative visits and removal of the stitches after 4 weeks may be needed. On the contrary, in the adhesion technique, the merocel splint was applied as a middle meatal spreader with the possibilities of re-inserting it for a further time till the MT stabilization ensues. There was no adhesion lysis needed.

In this study, although no statistically significant difference was observed from investigating the laterality of the MT status, LKS, LMS, and SIT scores,

as shown in Table 2, the right-handed surgeon may face difficulties especially in the suturing technique where the needle needed to be traversed from side to side intranasally, with more difficulty arising in the right side.

5. Conclusion

Although the efficacy of two different techniques addressing the floppy MT was stressed in this study, the primary emphasis should be prevention of turbinate destabilization, and the medialization techniques should not be carried out routinely in FESS. A meticulous surgical technique during FESS, through preserving the basal lamella and the most anterior superior part of the MT, is the most important factor for a proper turbinate position. However, in the current study, short- and medium-term (1, 3, and 6 months) outcomes were assessed. Further studies are needed for evaluation of the effect of medialization techniques on long-term (12 months and more) outcomes.

Conflicts of interest

There are no conflicts of interest.

References

- [1] Abelardo E, Sanuki T, Yumoto E. Medialization and stabilization of the middle turbinate using a nasal septal flap in endoscopic sinus surgery. *Philipp J Otolaryngol Head Neck Surg* 2006;21:42–4.
- [2] Ramadan HH, Allen GC. Complications of endoscopic sinus surgery in a residency training program. *Laryngoscope* 1995; 105:376–9.
- [3] Bassiouni A, Chen PG, Naidoo Y, Wormald PJ. Clinical significance of middle turbinate lateralization after endoscopic sinus surgery. *Laryngoscope* 2015;125:36–41.
- [4] Stammberger H, Posawetz W. Functional endoscopic sinus surgery. Concept, indications, and results of the Messerklinger technique. *Eur Arch Oto-Rhino-Laryngol* 1990;247: 63–76.
- [5] Zeid NG, Wahba BM, Elfouly MS, Abd Elmottaleb MA. Postoperative evaluation of middle turbinate medialization versus basal lamella relaxing incision in endoscopic sinus surgery. *Pan Arab J Rhinol* 2014;4:65–70.
- [6] Shikani AH. A new middle meatal antrostomy stent for functional endoscopic sinus surgery. *Laryngoscope* 1994;104: 638–41.
- [7] Thornton RS. Middle turbinate stabilization technique in endoscopic sinus surgery. *Arch Otolaryngol Head Neck Surg* 1996;122:869–72.
- [8] Bolger WE, Kuhn FA, Kennedy DW. Middle turbinate stabilization after functional endoscopic sinus surgery: the controlled synechia technique. *Laryngoscope* 1999;109: 1852–3.
- [9] Friedman M, Landsberg R, Tanyeri H. Middle turbinate medialization and preservation in endoscopic sinus surgery. *Otolaryngol Head Neck Surg* 2000;123:76–80.
- [10] Soler ZM, Hwang PH, Mace J, Smith TL. Outcomes after middle turbinate resection: revisiting a controversial topic. *Laryngoscope* 2010;120:832–7.
- [11] Nurse LA, Duncavage JA. Surgery of the inferior and middle turbinates. *Otolaryngol Clin* 2009;42:295–309.
- [12] Tan BK, Chandra RK. Postoperative prevention and treatment of complications after sinus surgery. *Otolaryngol Clin* 2010;43:769–79.
- [13] Lindemann J, Keck T, Rettinger G. Septal-turbinate suture in endonasal sinus surgery. *Rhinology* 2002;40:92–4.
- [14] Lund VJ, Kennedy DW. Quantification for staging sinusitis. International Conference on Sinus Disease: Terminology, Staging, Therapy. *Ann Otol Rhinol Laryngol Suppl* 1995; 104(Suppl):17–21.
- [15] Lund VJ, Kennedy DW. Staging for rhinosinusitis. *Otolaryngol Head Neck Surg* 1997;117:535–40.
- [16] Wilson TJ, Rowan NR, Wang EW. Middle turbinate manipulation and postoperative sinus obstruction in endoscopic endonasal skull-base surgery. *Int Forum Allergy Rhinol* 2018;00:1–15.
- [17] Sowerby LJ, Gross M. Olfactory and sinonasal outcomes in endoscopic trans-sphenoidal skull-base surgery. *Int Forum Allergy Rhinol* 2013;3:217–20.
- [18] Hopkins C, Gillett S, Slack R, Lund VJ, Brown JP. Psychometric validity of the 22-item sinonasal outcome test. *Clin Otolaryngol* 2009;34:447–54.
- [19] Silke S, Thomas H, Christina B, Sabina B, Walter H, Monika K, et al. Qualitative and quantitative assessment of taste and smell changes in patients undergoing chemotherapy for breast cancer or gynecologic malignancies. *J Clin Oncol* 2009;27:11.
- [20] Lazar RH, Younis RT, Long TE, Gross CW. Revision functional endonasal sinus surgery. *Ear Nose Throat J* 1992;71: 131–3.
- [21] Schaitkin B, May M, Shapiro A, Fucci M, Mester SJ. Endoscopic sinus surgery: 4-year follow-up on the first 100 patients. *Laryngoscope* 1993;103:1117–20.
- [22] Musy PY, Kountakis SE. Anatomic findings in patients undergoing revision endoscopic sinus surgery. *Am J Otolaryngol* 2004;25:418–22.
- [23] Chiu AG, Vaughan WC. Revision endoscopic frontal sinus surgery with surgical navigation. *Otolaryngol Head Neck Surg* 2004;130:312–8.
- [24] Bassiouni A, Naidoo Y, Wormald P-J. When FESS fails: the inflammatory load hypothesis in refractory chronic rhinosinusitis. *Laryngoscope* 2012;122:460–6.
- [25] Marple BF. Middle turbinate medialization for improved access during endoscopic sinus surgery. *Int Forum Allergy Rhinol* 2011;1:187–90.
- [26] Hewitt KM, Orlandi RR. Suture medialization of the middle turbinate during endoscopic sinus surgery. *Ear Nose Throat J* 2008;87:E11.
- [27] Hana BM, Killy SJ. Middle turbinate suture technique: a cost-saving and effective method for middle meatal preservation after endoscopic sinus surgery. *J Otolaryngol Head Neck Surg* 2012;41:407–12.
- [28] Chen PG, Bassiouni A, Wormald P-J. Incidence of middle turbinate lateralization after axillary flap approach to the frontal recess. *Int Forum Allergy Rhinol* 2014;4:333–8.
- [29] Dutton JM, Hinton MJ. Middle turbinate suture conchopexy during endoscopic sinus surgery does not impair olfaction. *Am J Rhinol Allergy* 2011;25:125–7.