Comparison by objective parameters in patients with chronic rhinosinusitis managed medically and surgically (with and without powered instruments)

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ABSTRACT

Objective: *To compare mucociliary clearance time and quality of life in patients who underwent sinus surgery using conventional and powered instruments, and in patients who were treated nonsurgically.*

Methods: *A total of 151 patients with chronic rhinosinusitis were included. Fifty-four patients were treated conservatively, 48 patients were managed surgically by using conventional instruments and 49 patients were managed by using a microdebrider. Kupferberg nasal endoscopy grades, 20-item Sino-Nasal Outcome Test scores, Lund-Mackay scores, and mucociliary clearance time were analyzed.*

Results: *On comparison among the groups, it was found that there was a significant difference between group A (nonsurgically treated) compared with group B (surgery by conventional means) or group C (surgery with microdebrider) in nasal endoscopic grades, Lund-Mackay scores, 20-item Sino-Nasal Outcome Test scores, and mucociliary clearance time. However, in comparison between groups B and C, there was no statistically significant difference.*

Conclusion: *Mucociliary clearance time tended to recover after starting treatment for chronic rhinosinusitis both after conservative treatment and after surgical treatment. Surgery provided better improvement in different objective scores in chronic rhinosinusitis. There exists no statistical difference in parameters independent of the instrument used for surgery.*

Mucus transport is impaired in chronic inflammatory diseases of the paranasal sinuses.[1] Before the advent of the microdebrider, traditional sinus surgery involved avulsing polyps from the surrounding soft tissue by using straight biting instruments, which often led to tearing of the adjacent mucosa and bleeding, which either obscured the operator's visual field and increased the risk of damage to the orbit or skull base, or necessitated premature cessation with incomplete removal of disease. The powered microdebrider is a rotary shaving device that precisely resects tissue. Its cutting, rather than pulling, action avoids the stripping of mucosa by minimizing tissue trauma and preserving normal mucosa, which is paramount in avoiding excessive scarring, synechiae formation, and resultant complications.[2] Postoperative recovery of mucociliary function depends on mucosal and ciliary regeneration. During the surgical procedure, it is especially important to reduce mucosal damage. When the mucosa is preserved or excision is limited to only the mucosal surface, ciliated cells usually regenerate within 6 months.[3]

The saccharin test is inexpensive and simple to perform, and its results are similar to those obtained by using a radioactively labeled particle. It has been proposed as a screening test to detect abnormal mucociliary clearance.[4] Patients with chronic rhinosinusitis (CRS) show worse quality-of-life (QOL) scores (for physical pain and social functioning) than those with chronic obstructive pulmonary disease, congestive heart failure, or angina.[5] The 20-item Sino-Nasal Outcome Test (SNOT-20) is one of the most widely used QOL instruments for sinonasal conditions.[6]

Endoscopic sinus surgery (ESS) for CRS is performed frequently by using a microdebrider. Conventional instruments are looked down upon, without much convincing evidence of superiority of powered instruments. As far as they are concerned, the patients still have persistent symptoms with variable frequency, irrespective of the surgical instruments adopted by the surgeon. A microdebrider is a costly instrument, with a recurring cost due to disposable blades. This study aimed to compare different outcome measurements in patients who underwent sinus surgeries with conventional instruments and with a microdebrider, and also in patients treated nonsurgically, and addressed the rationale of using powered instruments.

METHODS

The study was a single center, prospective, randomized study conducted in the Department of Otolaryngology—Head and Neck Surgery, Post Graduate Institute of Medical Education and Research, Chandigarh, India. A total of 151 patients, ages 14–70 years, with CRS (Rhinosinusitis Task Force)[7] were included. Patients with fungal disease, diabetes mellitus, or immunodeficiency, or those on immunosuppressive drugs were excluded. All the patients were evaluated with a detailed history before any treatment, had a noncontrast computed tomography (CT) (by using the Lund-Mackay (LM) system of grading[8]), SNOT-20 questionnaire,[9] rigid nasal endoscopy (NE) (grading by Kupferberg[10]) and mucociliary clearance time (MCT) by using the saccharin test.

MCT

The MCT test was done by the method as described by Andersen and Proctor[11] and Sakakura[12] All the patients were divided into a conservatively treated (group A) and surgically treated groups (groups B and C) as per a computerized randomization table. Group A included 54 patients who were treated nonsurgically with antihistamines, steroid nasal spray (fluticasone), decongestants, saline solution nasal drops, and a short course of antibiotics when needed. Group B included 48 patients who underwent surgery by using conventional instruments, and group C had 49 patients who underwent surgery by using powered instruments.

Follow-up Protocol

Patients in group A were followed up at 6 weeks and 12 weeks. Each time, they underwent NE, SNOT-20 score evaluation both at 6 and 12 week follow up, and CT scans of nose and para-nasal sinuses were done at 12 week follow up. All the patients in groups B and C were followed up on day 7, at 6 weeks, and at 12 weeks after the surgery.

Statistical Analysis

Statistical analysis was performed by using SPSS version 22 (SPSS Inc., Chicago, IL).

RESULTS

A total of 151 subjects were recruited during the study period and were divided into three groups. Group A (the conservative group) included 54 patients, group B (the conventional instrument group) included 48 patients, and group C (the microdebrider group) included 49 patients. The mean ± standard deviation (SD) age of patients (months) in group A was 35.56 ± 15.82 months (range, 16–65 months); in group B, 40.35 ± 14.29 months (range, 20–68 months); in group C, 39.71 ± 14.94 months (range, 18–68 months). Nasal

obstruction and facial pain and/or pressure were the most predominant symptoms seen in our study in 121 of 151 patients (80.13%). Mean ± SD for each parameter tested has been mentioned in Table 1 and intergroup comparison between group A and B, A and C and B and C has been mention in Table 2.

CT Findings

The mean ± SD LM scores of groups A, B, and C were 10.13 ± 4.97, 10.15 ± 4.83, and 10.39 ± 5.02, respectively at the beginning of the study. A CT was repeated after 12 weeks of treatment. The mean ± SD LM score improved to 7.85 ± 6.25 in group A, to 2.73 ± 3.24 in group B, and to 3.59 ± 4.33 in group C. On intergroup comparison, there was significant improvement between group A and the surgically treated groups (groups B and C) (groups A and B, $p = 0.00$; groups A and C, $p = 0.00$). No significant difference in LM score was observed between groups B and C ($p = 0.27$). Twenty patients in group A had a posttreatment LM score more than or equal to that of the pretreatment score. In groups B and C, all the patients (except two patients in group C) had improved postoperative LM scores.

SNOT-20 Score

The mean ± SD SNOT-20 scores in groups A, B, and C were 41.00 ± 11.44, 41.19 ± 9.70, and 46.33 ± 13.40, respectively, at the beginning of the study. Thirty-one of 54 patients in group A, 20 of 48 in group B, 23 of 49 in group C (23/49) had a SNOT-20 score of ≥40. The mean ± SD SNOT-20 score of group A patients improved to 25.83 ± 8.29 and 21.81 ± 7.99 on 6-week and 12-week follow-up, respectively. In group B, the mean ± SD SNOT-20 scores changed to 19.54 ± 2.40 and 12.73 ± 4.33 on 6-week and 12-week follow-up, respectively. Patients in group C showed improvement in the mean ± SD SNOT-20 score, from 46.33 ± 13.40 to 21.69 ± 6.52 and 12.80 ± 3.83 on subsequent follow-up at 6 weeks and 12 weeks. There was a significant difference in SNOT-20 scores when group A was compared with either groups B or C, both at 6-week and 12-week follow-up, but no significant difference could be seen when groups B and C were compared (between groups A and B at 6 weeks, $p = 0.00$, and at 12 weeks, $p = 0.00$; between groups A and C at 6 weeks, $p = 0.00$, and at 12 weeks, $p = 0.00$; and between groups B and C at 6 weeks, $p = 0.03$, and at 12 weeks, $p = 0.93$).

MCT

The mean ± SD MCT in group A was 43.33 ± 28.90 minutes (range, 17–120 minutes; in group B, 43.19 ± 26.05 minutes (range, 20–120 minutes); and, in group C, 48.88 ± 26.73 minutes (range, 22–120 minutes). MCT was found to be improved with treatment in all three groups. The mean ± SD MCT improved to 29.52 ±

Table 1 Parameters observed in all three groups before and after treatment

Groups	Number of patients	Mean value	Mean SE	SD	Variance
Conservative management (group A)					
NE score					
Pretreatment	54	1.85	0.100	0.737	0.544
Posttreatment, 6 wk	54	1.35	0.109	0.805	0.647
Posttreatment, 12 wk	54	1.09	0.138	1.014	1.029
LM score					
Pretreatment	54	10.13	0.677	4.976	24.756
Posttreatment, 12 wk	54	7.85	0.851	6.254	39.110
MCT					
Pretreatment	54	43.33	3.934	28.906	835.547
Posttreatment, 6 wk	54	29.52	2.322	17.067	291.273
Posttreatment, 12 wk	54	23.22	1.270	9.334	87.119
SNOT-20 score					
Pretreatment	54	41.00	1.557	11.440	130.868
Posttreatment, 6 wk	54	25.83	1.129	8.294	68.783
Posttreatment, 12 wk	54	21.81	1.087	7.991	63.852
Conventional surgery (group B)					
NE score					
Pretreatment	48	1.92	0.098	0.679	0.461
Posttreatment, 6 wk	48	.42	0.083	0.577	0.333
Posttreatment, 12 wk	48	.40	0.122	0.844	0.712
LM score					
Pretreatment	48	10.15	0.698	4.838	23.404
Posttreatment, 12 wk	48	2.73	0.469	3.247	10.542
MCT					
Pretreatment	48	43.19	3.761	26.054	678.836
Posttreatment, 6 wk	48	23.44	1.607	11.135	123.996
Posttreatment, 12 wk	48	16.35	0.922	6.390	40.829
SNOT-20 score					
Pretreatment	48	41.19	1.401	9.703	94.156
Posttreatment, 6 wk	48	19.54	0.347	2.405	5.785
Posttreatment, 12 wk	48	12.73	0.626	4.336	18.797
Surgery with microdebrider (group C)					
NE score					
Pretreatment	49	1.94	0.098	0.689	0.475
Posttreatment, 6 wk	49	.63	0.095	0.668	0.446
Posttreatment, 12 wk	49	.59	0.109	0.762	0.580
LM score					
Pretreatment	49	10.39	0.718	5.024	25.242
Posttreatment, 12 wk	49	3.59	0.619	4.335	18.788
MCT					
Pretreatment	49	48.88	3.819	26.731	714.568
Posttreatment, 6 wk	49	26.31	1.560	10.917	119.175
Posttreatment, 12 wk	49	16.96	0.917	6.416	41.165
SNOT-20 score					
Pretreatment	49	46.33	1.915	13.405	179.683
Posttreatment, 6 wk	49	21.69	0.931	6.520	42.509
Posttreatment, 12 wk	49	12.80	0.548	3.835	14.707

SE = Standard error; SD = standard deviation; NE = nasal endoscopy; LM = Lund-Mackay; MCT = mucociliary clearance time (minutes); SNOT-20 = 20-item Sino-Nasal Outcome Test.

Table 2 Intergroup comparison between groups A and B, A and C, and B and C

	A and B — Group	Mean ± SD	t	Sig. (2 tailed)	A and C — Group	Mean ± SD	t	Sig. (2 tailed)	B and C — Group	Mean ± SD	t	Sig. (2 tailed)
NE score, pretreatment	A	1.85 ± 0.737	−0.616	0.539	A	1.85 ± 0.737	−0.616	0.539	B	1.92 ± 0.679	−0.159	0.874
	B	1.92 ± 0.679	−0.618	0.538	C	1.94 ± 0.689	−0.618	0.538	C	1.94 ± 0.689	−0.159	0.874
NE score, 6 wk	A	1.35 ± 0.805	4.908	0.000	A	1.35 ± 0.805	4.953	0.000	B	0.42 ± 0.577	−1.703	0.092
	B	0.42 ± 0.577	4.908	0.000	C	0.63 ± 0.668	4.953	0.000	C	0.63 ± 0.668	−1.706	0.091
NE score, 12 wk	A	1.09 ± 1.014	2.810	0.006	A	1.09 ± 1.014	2.849	0.005	B	0.40 ± 0.844	−1.201	0.233
	B	0.40 ± 0.844	2.810	0.006	C	0.59 ± 0.762	2.849	0.005	C	0.59 ± 0.762	−1.200	0.233
LM score, pretreatment	A	10.13 ± 4.976	−0.262	0.794	A	10.13 ± 4.976	−0.262	0.794	B	10.15 ± 4.838	−0.241	0.810
	B	10.15 ± 4.838	−0.262	0.794	C	10.39 ± 5.024	−0.262	0.794	C	10.39 ± 5.024	−0.242	0.810
LM score, posttreatment, 12 wk	A	7.85 ± 6.254	3.979	0.000	A	7.85 ± 6.254	4.048	0.000	B	2.73 ± 3.247	−1.108	0.271
	B	2.73 ± 3.247	3.979	0.000	C	3.59 ± 4.335	4.048	0.000	C	3.59 ± 4.335	−1.111	0.270
MCT, pretreatment	A	43.33 ± 28.906	−1.007	0.316	A	43.33 ± 28.906	−1.011	0.314	B	43.19 ± 26.054	−1.061	0.291
	B	43.19 ± 26.054	−1.007	0.316	C	48.88 ± 26.731	−1.011	0.314	C	48.88 ± 26.731	−1.062	0.291
MCT, posttreatment, 6 wk	A	29.52 ± 17.067	1.125	0.263	A	29.52 ± 17.067	1.148	0.254	B	23.44 ± 11.135	−1.281	0.203
	B	23.44 ± 11.135	1.125	0.263	C	26.31 ± 10.917	1.148	0.254	C	26.31 ± 10.917	−1.281	0.203
MCT, posttreatment, 12 wk	A	23.22 ± 9.334	3.929	0.000	A	23.22 ± 9.334	3.999	0.000	B	16.35 ± 6.390	−0.465	0.643
	B	16.35 ± 6.390	3.929	0.000	C	16.96 ± 6.416	3.999	0.000	C	16.96 ± 6.416	−0.465	0.643
SNOT-20 score, pretreatment	A	41.00 ± 11.440	−2.175	0.032	A	41.00 ± 11.440	−2.158	0.033	B	41.19 ± 9.703	−2.159	0.033
	B	41.19 ± 9.703	−2.175	0.032	C	46.33 ± 13.405	−2.158	0.033	C	46.33 ± 13.405	−2.166	0.033
SNOT-20 score, posttreatment, 6 wk	A	25.83 ± 8.294	2.796	0.006	A	25.83 ± 8.294	2.829	0.006	B	19.54 ± 2.405	−2.148	0.034
	B	19.54 ± 2.405	2.796	0.006	C	21.69 ± 6.520	2.829	0.006	C	21.69 ± 6.520	−2.165	0.034
SNOT-20 score, posttreatment, 12 wk	A	21.81 ± 7.991	7.183	0.000	A	21.81 ± 7.991	7.407	0.000	B	12.73 ± 4.336	−0.080	0.936
	B	12.73 ± 4.336	7.183	0.000	C	12.80 ± 3.835	7.407	0.000	C	12.80 ± 3.835	−0.080	0.936

SD = Standard deviation; t = t value of t test; Sig. = significance (p value); NE = nasal endoscopy; LM = Lund-Mackay; MCT = mucociliary clearance time (minutes); SNOT-20 = 20-item Sino-Nasal Outcome Test.

17.06 minutes in group A, 23.44 ± 11.13 minutes in group B, and 26.31 ± 10.91 minutes in group C at the 6-week follow-up. At the 12-week follow-up, the mean ± SD MCT for groups A, B, and C were 23.22 ± 9.33, 16.35 ± 6.39, and 16.96 ± 6.41 minutes, respectively. The differences in mean MCT between group A and group B at 6 weeks and 12 weeks after treatment and between group A and C at 12 weeks were significant (groups A and B at 6 weeks, $p = 0.03$; and at 12 weeks, $p = 0.00$; and between groups A and C at 6 weeks, $p = 0.26$, and at 12 weeks, $p = 0.00$) There was no significant difference when different MCT values of groups B and C were compared at 6 and 12 weeks ($p = 0.20$ and $p = 0.64$, respectively).

NE

The mean ± SD NE score was 1.85 ± 0.73 in group A before treatment, which improved to 1.09 ± 1.01 after 12 weeks. In group B, the pretreatment mean ± SD NE score was 1.92 ± 0.67, which improved to 0.40 ± 0.84, at the 12-week follow-up. In group C, it improved from 1.94 ± 0.68 (pretreatment) to 0.59 ± 0.76 (12-week follow-up).

DISCUSSION

Patients with CRS constitute a major portion of patients who visited otolaryngology out patient department. The health impact of CRS on the patient is extensive. QOL scores of CRS (in terms of physical pain and social functioning) are worse when compared with other chronic diseases, *i.e.,* chronic obstructive pulmonary disease, angina, heart failure.[13] The patients with CRS are usually initially managed with conservative treatment. In case of there being no response, patients receive surgical intervention. Currently, surgery is being increasingly performed with the help of powered instruments, *i.e.,* microdebriders. Poetker[14] reviewed articles on the use of oral steroids in chronic sinusitis with and without nasal polyposis and the risks and benefits associated with its use. No treatment option is without adverse effects, failures, or risks. It is the patient who has to understand and ultimately decide on the treatment.

Through our study, we tried to compare different parameters between conservatively managed and surgically managed patients, and also to look for any differences in these parameters when surgery was performed by using conventional instruments (group B) or microdebriders (group C). These parameters were NE grades, SNOT-20 scores, LM CT scores, and MCT. During this study, we did not record any intraoperative complications, such as iatrogenic trauma or an extended average anesthetic time in relation to the surgical procedure. In our study, nasal obstruction and facial pain and/or pressure were the most predomi-

nant symptoms: 121 of 151 patients (80.13%). Pynnonen *et al.*[15] reported that the most commonly reported chronic symptoms were nasal obstruction (70%), postnasal drip (56%), fatigue (45%), and congestion (45%). MCT was significantly increased in CRS, with a pretreatment mean value of 53 minutes. After treatment, there was significant improvement in all the groups. In the present study, no statistically significant difference could be found when groups B and C were compared at the 6-week and 12-week follow-ups. Similar results were obtained in a study by Sakakura *et al.*[16]

In our study, there was no significant difference when groups B and C were compared ($p > 0.05$) in terms of SNOT-20 score at 12 weeks. The study by Bradley and Kountakis[17] was of 113 adult patients with 1 year of clinical follow-up after ESS. They found that a significant reduction in SNOT-20 symptom scores was achieved after ESS as early as 3 months after surgery, with an effect that remained significant through the 12-month mark. Overall, composite symptoms were improved at 3, 6, and 12 months after surgery. In a long-term study of 77 patients with chronic pansinusitis without polyposis with 3 years of follow-up after ESS, Giger *et al.*[18] found that 92% of patients showed a marked global improvement in symptoms after ESS, with a revision rate of 15%.

In our study, we also found that nasal blockage and facial pain and/or pressure were the symptoms that responded maximally to both conservative and surgical treatment. Although surgical intervention provided much better improvement in the SNOT-20 score than the conservative treatment, there was no difference in whether conventional or powered instruments were used. Ragab *et al.*[19] conducted a randomized trial that compared ESS with medical management of CRS. They found that both the medical and surgical treatment arms exhibited substantial improvements in a visual analog scale rating of sinus symptoms at 6- and 12-month follow-ups. They also found that patients with nasal polyps could obtain satisfactory results after ESS, which indicated that nasal polyps are not necessarily a negative prognostic factor for success after ESS. These results were echoed by a randomized medical versus surgical treatment trial for nasal polyposis conducted by Alobid *et al.*[20] Bhattacharyya[21] followed up 100 adults, with a mean follow-up of 19.0 months. After surgery, statistically significant decreases in major and minor symptoms were noted ($p < 0.001$ for all). The largest effect sizes were noted for the decreases in facial pressure, congestion, nasal obstruction, rhinorrhea, and headache. Our study was in accordance with this study.

In our study, we observed that there was no significant relationship between nasal polyposis and the pretreatment symptom score (average SNOT-20 score) and the degree of improvement after treatment. Similar

to this study, Bhattacharyya[22] indicated no substantial effect of nasal polyposis on the degree of improvement after ESS or postoperative symptom severity. Other studies corroborate similar improvement but note residual symptoms after surgery.[23,24] Contrary results were found in a study that described better QOL in nasal polyposis before and after ESS.[25] Functional endoscopic sinus surgery improves the olfactory outcome in patients with CRS without polyposis, with improvement in patient symptomatology and clinical findings, such as the visual analog scale score, the LM score, NE score, and olfactory score.[26]

ESS has traditionally been reserved for the treatment of medically refractory CRS. Nine patients in group B and six patients in group C had synechiae, which were released in local anesthesia. There were no differences between either method (conventional instruments or microdebrider) regarding recurrence of polyp, access to the ethmoidal complex, patency of middle meatal antrostomy, complications (synechiae), and symptoms. Patients with nasal polyposis require careful pathologic analysis, in which both the mucosal tissue and the airway mucus secretions could be involved. Despite expert surgical care, the presence of tissue eosinophils, specifically the presence of eosinophilic mucin as a sign of a more-severe eosinophilic disease undermines the clinical outcome and, therefore, implicates a more-aggressive and probably prolonged follow-up of postoperative medical management.[27] Bleier[28] reviewed many studies to find out the evolving pathogenesis of CRS and the importance of blending medical and surgical therapies to optimize patient outcomes.

CONCLUSION

From our study, it was found that MCT tended to recover after starting treatment for CRS both after conservative and surgical treatment. Surgery provided better improvement in different objective scores in CRS. There was no statistical difference in the different parameters, independent of the instrument used in surgery. Preoperative CT and NE were not reliable indicators of patients' symptom severity.

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