

achieve it. This technique minimizes the subjectivity, which is traditionally applied to reconstruct a perceived normal skull.

With the new application of this algorithm in our case series, there has been no demonstrated significant difference in OR time, estimated blood loss, or transfusion volume compared with a historical control group. Given the learning curve with the application of a new technique, we expect a reduction in the OR time with increasing experience, as all decisions required for reshaping the fronto-orbital bandeau are made preoperatively.

The AUC value is critical in the preoperative planning. It represents the objective difference or “error” remaining between the ideal curve and the expected postoperative curve achieved with a given number and location of osteotomies. The surgeon selects the algorithm solution based on the reduction of the AUC for a given number of osteotomies. These calculations are performed with CT-derived images of the osseous cranial vault. Our postoperative assessment performed with 3D imaging includes the soft tissues overlying the osseous skull. The 3D images provide a detailed depiction of the achieved result; however, these are not appropriate for comparison with the CT-derived images and calculated AUC. The time lapse between the preoperative and postoperative 3D images ranges from 3 to 9 months and the soft tissues overlying the remodeled skull precludes our ability to objectively compare the AUC preoperatively and postoperatively. This limitation due to skull growth and differing imaging modalities currently prevents accurate assessment of the postoperative result with objective numerical values. However, the 3D images provide a true representation of the postoperative contour achieved and offer a non-invasive low-risk modality for monitoring growth and contour correction at repeated intervals in the long term.

The novel application of this algorithm for the surgical correction of metopic, unilateral, and bilateral coronal synostoses enables the surgeon to predictably and reliably reshape the fronto-orbital bandeau. By eliminating the need to subjectively reshape the bandeau and select sites for the osteotomies, an improved contour relative to a normative, image data-derived ideal skull is achieved.

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## Aging as the Impact Factor on Septoplasty Success

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**Objective:** The aim of the study was to discuss the impact of aging on septoplasty success.

**Study Design and Setting:** This prospective case control study was conducted at the Umraniye Education and Research Hospital.

**Methods:** Our study group consists of 23 patients older than 60-year-old who have septal deviation and have previously been postponed for this surgery due to various reasons. Twenty-six patients under 40-year-old are randomly chosen as the control group who were running to septoplasty. Postoperative Glasgow Benefit Inventory Index, preoperative and postoperative NOSE score, and nasal mucociliary clearance time (MCCt) were noted for both the groups. All collected data were compared between the groups.

**Results:** In both the groups, postoperative NOSE scores decreased significantly compared to preoperative values ( $P < 0.01$ ). This decrease was not significantly different between the groups. In both the groups, a significant decrease was noted in nasal MCCt with surgery ( $P = 0.004$ ). However, this difference between two groups was not statistically significant. In addition, the Glasgow Benefit Inventory (GBI) index of control group was notably higher than the study group and this was statistically significant ( $P = 0.027$ ). Also, the decrease of NOSE scores was conversely related to high GBI indexes and this is statistically significant ( $P = 0.005$ ).

**Conclusion:** For many surgical procedures, aging is considered as one of the important prognostic factors on success. To date no study in the literature discussed this relationship between aging and the success of septoplasty. At this point, our results showed that septoplasty is a successfully performed procedure in all ages. But, satisfaction of patients is statistically decreasing with aging.

**Key Words:** Age, Glasgow benefit inventory, nasal mucociliary clearance, success of septoplasty

Nasal obstruction is one of the major symptoms in otolaryngology practice.<sup>1</sup> The etiology of nasal obstruction can vary such as septal deviation, turbinate hypertrophy, concha bullosa, nasal polyps, and other sinonasal disorders.<sup>2,3</sup> Septal deviation is the most frequent cause of nasal dysfunction and nasal blockage.<sup>3</sup> Even small deviations in key areas have been shown to adversely affect nasal airflow, mucociliary clearance, and the external appearance of the nose.<sup>4</sup>

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Septoplasty is the first preferred procedure performed for the treatment of the septal deviation. Improving nasal airflow is the primary goal of this operation. Epistaxis, sinusitis, obstructive sleep apnea, and headaches are other rare indications for septoplasty.<sup>4</sup> There are many studies and reviews about the improving effect of septoplasty on quality of life (QOL). Many methods such as rhinomanometry, acoustic rhinometry, QOL questionnaires, NOSE score, and nasal mucociliary clearance time (MCCt) have been used to evaluate indication and outcomes of surgeries for nasal obstruction.

In this study, we aimed to discuss the age factor for the success of the operation considering improvement on QOL after the operation. Here, we investigated the efficacy of septoplasty on the QOL even in advanced-age patients compared to earlier decades in the light of NOSE score, nasal MCCt, and Glasgow Benefit Inventory index.

## MATERIAL AND METHODS

### Study Objectives and Design

Our objective was to determine the efficacy of septal surgery on the QOL in different age groups by evaluating NOSE score, nasal MCCt, and Glasgow Benefit Inventory (GBI) index before and 6 months after the surgery.

### Setting

This prospective study was conducted at the Umraniye Education and Treatment Hospital in Turkey. It was approved by the Umraniye Education and Treatment Hospital Ethical Committee and informed consent was obtained from the participants. The present study received no industrial support.

### Subjects and Patient Characteristics

Individual investigators were responsible for allocating patients into the appropriate study groups. A total of 49 patients were enrolled in the study, whose completed surgery was analyzed. Twenty-three of the patients were over 60-year-old (study group) and 26 were under 40-year-old (control group). Patients were excluded based on the following criteria: (1) a history of previous endonasal surgery, (2) a history of underlying immunologic diseases that might interfere with wound healing, including acquired immunodeficiency syndrome, cystic fibrosis, immotile cilia syndrome, and systemic diseases, (3) heavy smokers, and (4) patients with chronic sinusitis or nasal polyposis. Outcome assessors were blinded.

### Surgical Procedure

All septoplasties were performed by the same surgery team, under local anesthesia. Diazepam and atropine were used for premedication, 30 to 45 minutes before operation. Anesthesia with 2% lidocaine with 1:200,000 epinephrine was infiltrated submucosally before incision. Standard septoplasty was performed with the mucoperichondrial flap kept intact. We placed Doyle internal nasal splint and kept 2 days in nasal cavities before removal. Postoperatively, to prevent infection and pain, all patients in both groups were given the same systemic antibiotics and analgesics. In both the groups, patients were instructed to use normal saline nasal spray in both nostrils 10 times per day.

### Outcome Measures

Both the groups were subjected to the same NOSE score, saccharine time test to measure nasal MCCt, and Glasgow Benefit Inventory index.

### Subjective Symptom Determining With NOSE Score

Nasal obstruction symptom evaluation was performed with NOSE score: nasal congestion or stuffiness, nasal blockage or obstruction, trouble breathing through nose, trouble sleeping, and unable to get enough air through the nose during exercise or exertion.

We determined patients with the NOSE score before and after the surgery.

### Objectively Measurement of Nasal Mucociliary Clearance

The nasal mucociliary activity was evaluated with saccharin time (ST) measurement for both nasal sides. Saccharin time measurement was performed as Stanley described on both sides inferior to inferior conchae without the use of a topical anesthetic agent to evaluate nasal mucociliary activity before and after septoplasty. The mean and standard deviation of ST were obtained.<sup>5</sup>

### Glasgow Benefit Inventory Index

The GBI index measures QOL in 3 sections: social, general, and physical. It involves 18 questions; 12 of them evaluate general QOL improvement, whereas 3 of them relate to social and physical improvement. Each question has 5 possible options, wherein a score of 5 shows most favorable outcome and 1 least favorable outcome. A score of 3 shows no change. In our study, the GBI index was the subjective and patient-dependent tool used to measure the QOL of patients who were operated for septal deviation.<sup>6</sup>

### Statistical Analysis

The IBM SPSS Statistics 22.0 program was used for all statistical analyses. Although study data were being determined, descriptive statistical methods (mean, standard deviation, and median) were used as the Mann-Whitney U test to compare the parameters which do not show normal distribution between the two groups and the Wilcoxon Signed Rank test for comparing in each group. Spearman rho correlation analysis was used to observe the relations between parameters. Results were determined in the safety zone of %95 and significance at  $P < 0.05$  level.

## RESULTS

Preoperative and postoperative NOSE scores in the study group were  $14.74 \pm 2.82$  and  $2.83 \pm 3.54$ , respectively ( $P = 0.001$ ). Also, preoperative NOSE scores were evaluated as  $14.54 \pm 2.83$  in the control group and noted as  $3.23 \pm 4.55$  after the operation ( $P = 0.001$ ). Although, in both of the groups, postoperative NOSE scores decreased significantly after the surgery, this decrease was not significantly different between the groups ( $P = 0.809$ ), (Table 1), (Fig. 1).

In both the groups, a significant decrease was noted in nasal MCCt with surgery ( $P = 0.004$ ). But the difference between two groups was not statistically significant ( $P = 0.566$ ) (Table 1), (Fig. 2).

Glasgow Benefit Inventory indexes of the control group were notably higher than the study group and this was statistically significant ( $P = 0.027$ ) (Fig. 3). When we compared the relationship between the decrease of NOSE score and MCCt with GBI indexes, decrease of NOSE score were statistically significant with high GBI indexes ( $P = 0.005$ ), (Fig. 4). But, when we evaluated the decreases of nasal MCCt and GBI indexes, there was no statistically significant connection ( $P = 0.759$ ).

## DISCUSSION

Septal deviation is the most frequently detected reason of nasal blockage and septoplasty is one of the most commonly performed

**TABLE 1.** Differences of NOSE, MCCt and Glasgow Inventory Scores between the Groups

		Study Group	Control Group	<sup>†</sup> P
		Mean ± SD (Median)	Mean ± SD (Median)	
Nose	Preop	14.74 ± 2.82 (15)	14.54 ± 2.83 (14)	0.740
	Postop	2.83 ± 3.54 (2)	3.23 ± 4.55 (2)	0.903
	Difference	11.91 ± 4.56 (13)	11.31 ± 4.96 (12)	0.809
	Preop–Postop <sup>‡</sup> P	<sup>‡</sup> 0.001**	<sup>‡</sup> 0.001**	
MCCt <sup>§</sup>	Preop	12.78 ± 4.12 (12)	10.69 ± 4.93 (10.5)	0.145
	Postop	9.83 ± 7.71 (7)	7.27 ± 3.96 (7)	0.144
	Difference	2.95 ± 8.73 (3)	3.42 ± 5.05 (3)	0.566
	Preop–Postop <sup>‡</sup> P	<sup>‡</sup> 0.004**	<sup>‡</sup> 0.002**	
Glasgow		71.87 ± 6.77 (71)	74.42 ± 8.92 (77.5)	0.027*

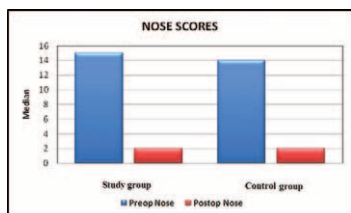
<sup>†</sup> Mann-Whitney U test.  
<sup>‡</sup> Wilcoxon Signed Ranks test.  
<sup>§</sup> MCCt, mucociliary clearance time.  
 \* P < 0.05.  
 \*\* P < 0.01.

surgeries by otolaryngologists.<sup>1</sup> Septoplasty can be performed by a traditional way or directed endoscopically.<sup>4</sup>

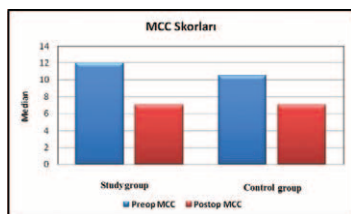
There are some factors affecting septoplasty success as –perop bleeding, fracture of quadrangular cartilage according to previous traumas, technique of septoplasty (close, open, and endoscopically approach) and nasal packing material.<sup>7,8</sup> Although aging is important for success of many surgical procedures, it is still not discussed in the present literature for septoplasty.

In the literature, the NOSE score and MCCt are usually used to evaluate the success of septoplasty. Nowadays different kinds of QOL questionnaires were described for the evaluation of satisfaction of patients for the procedure. The Glasgow Benefit Inventory index is a well-designed questionnaire to determine the benefit of patient from the operation. It is sensitive and patient-dependent for the changes in health.<sup>6</sup>

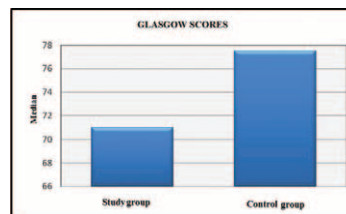
Gandomi et al evaluated outcomes of septoplasty by the NOSE score and found significant improvement 3 months after surgery.<sup>1</sup> Bezerra et al investigated any difference in gender for septoplasty success and determined disease-specific QOL by the NOSE questionnaire. They found significant improvement with NOSE score



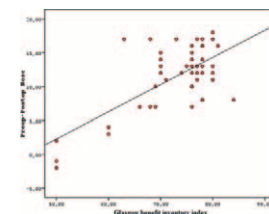
**FIGURE 1.** Evaluation of NOSE scores comparing preoperative values with postoperative values in the study groups.



**FIGURE 2.** Decrease in nasal mucociliary clearance between the groups.



**FIGURE 3.** Evaluation of Glasgow benefit inventory scores in the study and control groups.



**FIGURE 4.** Comparison of relationship between the decrease in the NOSE score and Glasgow benefit inventory indexes.

but did not detect any difference in gender.<sup>9</sup> In our study, NOSE scores showed improvement for both the groups regardless of age according to data.

Uslu et al showed the decrease of MCCt after septoplasty and connected this data with the success of operation.<sup>10</sup> Sakallioğlu et al declared that septoplasty operation positively affects the MCC mechanism.<sup>11</sup> We also found MCC time significantly decreased after septoplasty for both the groups. Improvement in MCCt after septoplasty is independent from the age factor.

Hytönen et al reported in 2012 an investigation about septoplasty for enhancing the QOL. They used a generic 15-dimension (15D) and the 22-item sinonasal outcome test (SNOT-22) questionnaires before and 6 months after surgery. They found that total SNOT-22 score was reduced, showing that the nasal symptoms decreased with septoplasty by the way health-related QOL became poorer. They claimed septoplasty enhances the QOL if the nasal symptoms are moderate or severe, but if the symptoms are mild and the patient is elderly, the surgeon has to be more careful to decide to operate.<sup>12</sup> We used the GBI index as QOL questionnaire after septoplasty individually for both the groups and found that the GBI index was statistically significant post-operatively. However, when we compared the groups, the GBI index of control group was statistically higher than the study group (P = 0.027). According to these data, we claim that septoplasty is a successfully performed procedure for all ages but satisfaction of patient for this procedure is higher in earlier ages than elderly. Also we have seen that decrease of NOSE scores is more effective subject on the QOL according to the decrease of nasal MCCt related to the GBI indexes. We think that the subjectively determining both NOSE score and GBI index personalizes the benefit of operation.

Septal deviation could be neglected by the younger people because of their intensive work schedule. So, physicians can receive these people at an advanced age. In this case, the physician should consider that septoplasty is a successfully performed procedure regardless of age but has better results for satisfaction of patient in earlier ages.

**CONCLUSION**

Sometimes physicians may consider septoplasty as an negligible procedure for the advanced-age patients. But they also should know QOL is valuable for all ages. At this point, our study supposed that

septoplasty is a successfully performed procedure at all ages but subjectively has more satisfactory results in early-age patients.

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## Efficacy of N-Acetylcysteine on Wound Healing of Nasal Mucosa

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**Abstract:** Postoperative nasal mucosa healing is a highly complex and organized process, and the success rates of endoscopic sinus

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surgery and septoplasty surgeries are closely associated with the postoperative wound healing processes. In this experimental study, the authors' aim was to use histopathologic examination to investigate the effects of N-Acetylcysteine (NAC) on the wound healing of rat nasal mucosa after mechanical trauma. Twenty-one Sprague-Dawley rats were randomly divided into 3 groups: the nontreated group (N = 7), the control saline group (N = 7), and the NAC group (N = 7). No treatment was given to the nontreated group for 15 days. The control saline group received intraperitoneal injection of saline (2.5 mL/kg, intraperitoneal) for 15 days and the NAC group was intraperitoneally injected with NAC at a dose of 300 mg/kg/day for 15 days. At the beginning of the study, unilateral mechanical nasal trauma was induced with an interdental brush inserted through the right nostril in all rats. Samples were stained using hematoxylin and eosin solution, and were examined by a pathologist using a light microscope. The severity of inflammation was milder in the NAC group compared with that in the nontreated and saline groups ( $P < 0.05$ ). The subepithelial thickness index was lower in the experimental group ( $P < 0.05$ ). Goblet cell loss was reduced in the experimental group compared with the nontreated and saline groups ( $P < 0.05$ ). NAC decreases inflammation and goblet cell loss. Therefore, NAC has potential beneficial effects on the wound healing of nasal mucosa in rats.

**Key Words:** N-Acetylcysteine, nasal mucosa, wound healing

Nasal mucosa provides many functions such as temperature regulation by warming and humidifying the incoming air and preventing foreign bodies from occluding the airway.<sup>1</sup> To perform these functions, a healthy mucociliary clearance mechanism and normal cell structure are needed, because the nasal mucosa is lined by respiratory epithelium. The function of mucociliary clearance mechanism is easily disrupted by a number of conditions including trauma, surgery or foreign body exposure, and the wound healing is a time-taking process.<sup>2</sup> Postoperative nasal mucosa healing is a highly complex and organized process and it has been investigated by a limited number of studies.<sup>3,4</sup>

Endoscopic sinus surgery and septoplasty are commonly performed otorhinolaryngologic surgeries and the success rates of these surgeries are closely associated with the postoperative wound healing processes. The effects of anti-inflammatory drugs such as corticosteroids and caffeic acid phenethyl ester (CAPE) on postoperative nasal mucosa healing have been investigated in previous studies.<sup>5,6</sup>

N-Acetylcysteine (NAC), a thiol compound, is the N-acetyl derivative of L-cysteine, which has anti-inflammatory, antioxidant, and mucolytic properties. These properties have been investigated by numerous studies.<sup>7–9</sup> To our knowledge, however, no study has been reported regarding the potential histopathologic effects of NAC on nasal mucosa healing. Thus, the current study was aimed to present the potential histopathologic effects of intraperitoneally administered NAC on nasal mucosa healing in traumatized rats.

## MATERIALS AND METHODS

The current study was conducted in accordance with Guide for the Care and Use of Laboratory Animals issued by the National Institutes of Health, Commission on Life Sciences, and the National Research Council.<sup>10</sup> Twenty-one Sprague-Dawley rats weighing 180 to 220 g were randomly divided into 3 groups: the nontreated group (N = 7), the control saline group (N = 7), and the NAC group