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Effect of Nasal Surgery on Sleep-Related Breathing Disorders

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Objective/Hypothesis: Single cases of patients who have experienced obstructive sleep apnea (OSA) and who recovered completely after nasal surgery have been described in various studies. The purpose of this study was to evaluate the efficacy of only nasal surgery 1) in a group of patients with obstructive sleep apnea and 2) in simple snorers. _Study Design:_ A prospective, controlled study with 26 adult patients who underwent nasal surgery as single treatment of their sleep-related breathing disorders. The cases were evaluated based on the severity level of their preoperative Apnea Hypopnea Index (AHI). _Material and Methods:_ Between August 1996 and July 2000, 26 patients who snored and had impaired nasal breathing underwent attended polysomnography in the sleep laboratory as single treatment nasal surgery was performed. Postoperative polysomnographic findings and complications were reviewed. _Results:_ Nineteen of 26 patients (73.1%) were diagnosed as having OSA. Seven patients were simple snorers with an AHI below 10. The surgical response rates, defined as greater than or equal to 50% reduction in the postoperative AHI and a postoperative AHI of less than 20, was 15.8% in the apneics. For the whole group, the AHI decreased postoperatively from 31.6 to 28.9. However, daytime sleepiness improved significantly and arousals decreased significantly in both apneics and simple snorers after nasal surgery. _Conclusions:_ We conclude that nasal surgery has a limited efficacy in the treatment of adult patients with sleep apnea. Nevertheless, nasal surgery significantly improves sleep quality and daytime sleepiness independent of the severity of obstructive sleep-related breathing disorders. _Key Words:_ Snoring, obstructive sleep apnea, nasal congestion, nasal surgery, adults.

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INTRODUCTION

The observation that nasal obstruction may affect breathing during sleep has been well known for more than a century. Lavie published an excellent review of studies performed in the 19th century.[1] Cline[2] and Wells[3] first described surgical relief of excessive daytime sleepiness after nasal surgery.

A relationship between nasal congestion and sleep-related breathing disorders may also be assumed when recent epidemiologic data are taken into consideration. Ancoli-Israel et al.[4] observed a septum deviation in 6 of 9 patients with obstructive sleep apnea (OSA); Deegan and McNicholas[5] examined a total of 250 patients and reported nasal septum deviation in 15% of the patients and in 13% of the healthy control subjects. Mayer-Brix[6] found a highly limited nasal ventilation in 14.3% of 431 patients with OSA.

What are the effects of nasal surgery with respect to the severity of an obstructive sleep-related breathing disorder? Some cases are known in which patients recovered from their OSA after rhinosurgical intervention only.[7,8] On the other hand, Simmons et al.[9] reported as early as 1977 about cases in which no distinct improvement of the Apnea Index (AI) was achieved, although the patients subjectively experienced a partial improvement of their condition.

The purpose of this study was to evaluate the efficacy of only nasal surgery 1) in a group of patients with obstructive sleep apnea and 2) in simple snorers.

MATERIALS AND METHODS

Patient and Surgery Selection

The study was carried out according to the principles stated in the Declaration of Helsinki.

Only patients who experienced snoring in combination with day- and nighttime nasal congestion were included in the study. Patients with malformations and anomalies of the head or throat were excluded. Within an observation period of 5 years (August 1996–July 2000), 26 patients fulfilled the criteria and gave their written consent to an examination in the sleep laboratory pre- and postoperatively. A total of 25 male and one female (case no. 1) patients aged 34 to 62 years were included in the study.

Polysomnographic Methods

Each patient underwent a fully attended 12-channel polysomnography comprising a simultaneous recording of the following parameters: 2 electroencephalographic (EEG) leads, 2 electromyographic (EMG) leads for the muscular system of the floor

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of the mouth and the tibialis anterior muscle, 2 electro-oculogram (EOG) leads, and 1 electrocardiogram lead. In addition, the following devices were used: one probe for measurement of peripheral oxygen saturation, one each of the thorax and abdomen belt for measurement of breathing movements, one probe for measurement of the combined oronasal airflow, one probe defining the body position, and one microphone recording the breathing sounds. The evaluation of the different sleep stages was carried out manually according to standard criteria.[10] Apnea was defined as an interruption of the breath flow for at least 10 seconds measured at the nasal vestibule. Hypopnea was defined as a decrease of the breath flow by at least 50% for 10 seconds. A desaturation was defined as a decrease in peripheral oxygen saturation by at least 4%.

Increases in the activity in both EEG and both EOG leads and in the EMG lead for the floor of the mouth for at least 3 seconds were rated as arousals.

The following parameters were evaluated: the Apnea Hypopnea Index (AHI), the Arousal Index, and the Oxygen Desaturation Index (ODI). All indices are defined as number of events per hour of sleep.

The classification of OSA was performed according to Viner[11]; the severity was rated mild with an AHI of 10–29, moderate with values from 30 to 49, and severe 50 and over.

Other Parameters

Excessive daytime sleepiness was measured using the Epworth Sleepiness Scale (ESS).[12] Nasal resistance (NR) was determined according to the Standard Committee[13] using active anterior rhinomanometry (ATMOS Rhinomanometer 300; Atmos GmbH, Germany) at 150 Pa before and 10 minutes after application of xylometazoline nasal spray in both nostrils.

Surgical Techniques and Postoperative Evaluation

Nasal surgery under intubation anesthesia was performed as the only surgical procedure, with bipolar cauterization used for hemostasis. The procedures consisted of 7 septorhinoplasties, 13 septoplasties, 4 septoplasties with bilateral paranasal sinus surgery, 1 case of only nasal tip surgery, and 1 case of bilateral surgery on the nasal valves.

A follow-up examination was carried out in the same sleep laboratory recording the same parameters at least 3 months after surgery.

Criteria for Successful Surgical Response and Statistical Analysis

Recovery of a patient was concluded if the AHI had decreased by at least 50% and was below 20.[14]

In the following paragraphs, the means ± standard deviations (SD) of the means, the median, and the range are given. Statistical significance of the results was evaluated using the paired Student *t* test. A *P* value of .05 was considered statistically significant.

RESULTS

When surgery was performed, the patients (25 males, 1 female) were at a mean age of 52.5 years (± 8.4 SD; median, 56; range, 32–64) with a mean body mass index (BMI) of 29.2 kg m^{-2} (± 4.2 SD; median, 29.2; range, 20.6–39.1). The ESS score averaged 11.9 (± 4.7 SD; median, 12; range, 2–24).

Preoperative values for NR with and without decongestion are given in Table I. In Table II the preoperative results of the polysomnography are given. A severe OSA was found in 7, a moderate OSA in 3, and a mild OSA in 4 patients. Seven patients did not exhibit sleep apnea and had to be classified as simple snorers. The corresponding arousal index for all patients was 31.1.

The BMI remained nearly identical (Table II). After surgery the ESS score fell to 7.7 (Table I).

Values for NR significantly decreased without decongestion (Table I).

A control polysomnography was performed 3 to 50 months postoperatively (average, 12.7 ± 11.9 mo). It revealed a distinct reduction of the AHI in all patients with values between 0.4 and 76.8 (Table II). The following classification could be obtained postoperatively: 7 patients exhibited severe OSA, 3 patients moderate OSA, 7 patients mild OSA, and 9 patients showed no sleep apnea. The AI fell down to 23.0.

A recovery (50% decrease of the AHI with values below 20) could be achieved in 3 of 19 patients with OSA. This corresponds to a recovery rate of 15.8% with respect to the OSA group. One of these patients had severe OSA and 2 had mild OSA before surgery. Patient No. 25 improved from AHI 75.4 to 26.4 postoperatively. On the other hand, 4 patients (nos. 6, 12, 13, and 18) developed OSA of a higher severity.

For the whole group, the decrease in the AHI and ODI was statistically not significant ($P > .05$), whereas the changes with respect to the Arousal Index ($P = .0336$) and the ESS ($P = .0016$) were statistically significant.

Complications

In one patient (3.8%), a hematoma of the nasal septum occurred on the second postoperative day, which could be treated by one single puncture. In another patient, a small necrosis of the mucosa within the area of the nasal valve was observed, which healed spontaneously. One subject showed an allergic reaction to plaster of Paris.

DISCUSSION

The present study has the longest postoperative observation period hitherto published of more than 1 year on average. Only another nine publications on this topic exist, which state the severity of OSA pre- and postoperatively (see Table III). Altogether 130 patients from eight different studies were assessed.[15–23] The postoperative examination period was short, from 1[16] to 44 months.[15] With the exception of the oldest of those studies, which describes a significant postoperative reduction of the AI from 37.8 to 26.7 in a total of 9 patients, no other working group was able to determine a significant reduction of the severity of OSA for the respective patient group (see Table III).

In four studies[17,20,21,23] in which a total of 58 of the mentioned 130 patients were included, even an increase of the AHI and the AI was found. The changes, however, were also not significant.

Verse et al.[23] reported that the severity of OSA increased substantially in two patients who had been operated on because of massive nasal polyposis. Although adequate mouth respiration was re-established, the AHI rose from 14 preoperatively to 57.7 postoperatively. Both

TABLE I.
Nasal Resistance (NR) and Daytime Sleepiness Before and After Nasal Surgery.

Patient No.	ESS Before	ESS After	NR Native Before	NR Native After	NR Decon. Before	NR Decon. After
1	11	10	820	900	1144	840
2	13	1	680	540	652	608
3	6	4	896	1028	1260	1232
4	11	8	592	652	764	904
5	8	3	No data	No data	No data	No data
6	13	9	112	304	412	408
7	7	6	649	800	866	880
8	10	14	268	492	424	532
9	2	3	260	156	292	160
10	20	14	332	744	588	596
11	15	9.5	636	600	744	904
12	9	12	No data	No data	No data	No data
13	18	22	167	480	766	1088
14	13	5	316	336	420	344
15	12	7	No data	No data	No data	No data
16	17	3	No data	No data	No data	No data
17	12	10	424	732	576	860
18	8	12	800	864	949	844
19	6	3	683	944	1266	992
20	7	5	644	536	976	1352
21	13	3	280	616	276	880
22	15	1	916	640	972	1088
23	14	9.5	No data	No data	No data	No data
24	14.5	8	400	644	658	836
25	10	4	No data	No data	No data	No data
26	24	15	416	700	744	670
Mean	11.87	7.73	514.55	635.4	737.45	800.9
SD of mean	4.7	4.96	240.83	214.36	289.04	289.42
Median	12	8	508	642	744	852
P value		.0004		.0089		.2132

ESS = Epworth Sleepiness Scale; Decon. = after decongestion; NR = nasal resistance; SD = standard deviation of mean.

patients developed severe OSA with corresponding symptomatology, which had not existed preoperatively. Both patients needed nasal CPAP treatment postoperatively. Dagan[24] describes a similar course in two cases after septorhinoplasty. In the present study group, an increased severity of OSA was also observed in 4 patients (patient nos. 6, 12, 13, and 18). Therefore, the established medium-term results correspond to the short-term results published in the literature.

However, in the present study group, a significant reduction of the arousals and a highly significant reduction of the daytime sleepiness were determined. A comparative result had already been published by Lavie et al.[25] in 1982. Despite the fact that in their study group there was also no polysomnographically measurable improvement of OSA after septorhinoplasty, 12 of 14 patients felt less tired during the day and exhibited a better sleep quality.[25] Corresponding results were also reported for sleep apneics when nasal dilators were used.[26–28]

The results obtained with the present patient group indicate that the reduction of daytime sleepiness and the improvement of sleep quality do not depend on the severity of a sleep-related breathing disorder, because significant changes were also found when simple snorers and patients with OSA were assessed separately. Accordingly, similar results were achieved after optimizing nasal ventilation in simple snorers.[26,29]

Although it seems to be true that in the study group it was impossible to achieve an improvement of OSA through successful nasal surgery, 3 patients enrolled in this study recovered from their OSA after only nasal surgery. Unfortunately, in the literature different criteria of measuring success have been applied; therefore, in the present study a strict criterion according to Sher et al.,[14] namely, an AHI reduction by at least 50% *and* values below 20, was applied. For the present study group, the success rate was calculated for 15.8% (3 of 19 patients). Data given in the literature vary between 0%[17,23] and

TABLE II.
Polysomnographic Data Before and After Nasal Surgery.

Patient No.	BMI Before	BMI After	AHI Before	AHI After	ODI Before	ODI After	Arousal Index Before	Arousal Index After
1	20.6	20.6	0.8	0.4	4.9	11.6	14.2	11
2	27.0	25.6	0.9	1	3.2	1.8	16.7	1.6
3	30.4	29.8	2.8	8.2	17.3	50.2	10.7	37.5
4	30.7	32.3	4.2	3.9	20.2	12	12.7	0.6
5	25.9	26.2	6.2	7.9	12.4	16	8.2	4.8
6	33.3	33.3	6.9	15.3	49	73.1	32.4	22.5
7	24.8	25.1	7	3.4	9.6	7.7	6.4	0.9
8	29.4	28.7	10.2	17.9	6	24.1	19.4	6.9
9	26.0	26.3	16.1	17.5	18.5	15.8	17.4	13.9
10	30.6	29.7	20.1	7.2	50	24.8	8.7	16.2
11	25.4	26.6	21.4	15	7.5	17.4	28.5	42
12	29.4	29.8	21.5	76.8	34.3	80.3	21.7	48.2
13	28.3	28.3	22.7	38.0	45	35.1	21.1	36.5
14	24.5	24.2	23.7	9.6	36.6	10.5	29.1	0.7
15	30.9	31.6	25.8	14.2	42.8	46.2	37.5	32.7
16	27.4	26.8	29.7	16.9	55.9	41.3	45.7	18.2
17	23.2	24.1	30.9	48	34.2	63.3	32.7	35.2
18	30.4	29.7	35.4	54.3	38.7	55.6	27.9	24.4
19	39.1	39.9	48	48.8	63.6	28	23	12.6
20	29.0	29.2	64.4	6.6	45.2	10.9	58.8	3.2
21	26.9	27.3	64.8	63	61	70	72.4	63.8
22	31.6	31.6	67.2	64	66.9	67	62.4	22.6
23	35.6	37.8	67.8	56.9	72.1	72.9	40.2	24.6
24	33.7	31.1	69.3	55.7	96.3	65.6	71.2	43.5
25	36.8	36.5	75.4	26.4	70	61.7	29.3	20.9
26	27.3	27.3	77.6	75.3	85.6	69.9	61.3	53.5
Mean	29.16	29.20	31.57	28.93	40.26	39.72	31.14	23.02
SD of mean	4.18	4.28	25.6	24.73	25.81	25.2	19.42	17.53
Median	29.18	28.99	23.2	17.2	40.75	38.2	28.2	21.7
P value		.8383		.5216		.8964		.0336

BMI = body mass index; AHI = Apnea Hypopnea Index; ODI = Oxygen Desaturation Index; SD = standard deviation.

33%.[15] From these raw data, available for 57 patients, an overall success rate of 18% was calculated.

As described in the *Methods* section, the patients in the series underwent different surgical procedures. Two patients (nos. 2 and 23) did not undergo any septal surgery. This causes a certain heterogeneity of the group. Nevertheless, patient nos. 2 and 23 showed results comparable to the other subjects (Tables I and II).

TABLE III.
Effect of Nasal Surgery on OSA in Adults.

Author	No.	Follow-up	AI Before	AI After	AHI Before	AHI After	*P* value
Rubin, 1983[15]	9	1–6	37.8	26.7			<.05
Dayal, 1985[14]	6	4–44			46.8	28.2	NS
Caldarelli, 1985[21]	23	k.A.	44.2	41.5			NS
Aubert-T., 1989[16]	2	2–3	47.5	48.5			NS
Sériès, 1992[17]	20	2–3			39.8	36.8	NS
Sériès, 1993[18]	14	2–3	17.8	16			—
Utley, 1997[20]	4	k.A.			11.9	27	—
Verse, 1998[22]	2	3–4	9.2	47.3	14	57.7	—
Friedman, 2000[19]	50	>1.5			31.6	39.5	NS

AI = Apnea Index; AHI = Apnea Hypopnea Index; NS = not significant.

TABLE IV. Long-Term Results of Surgical Procedures in the Treatment of OSA. (Data taken from references 30–33.)	
Procedure	Success Rate
Tracheotomy	98%
Maxillomandibular advancement	>90%
Adenotomy and/or tonsillectomy in children	85–95%
Tonsillectomy in adults	up to 89%
LAUP	49.2–59.2%
UPPP selected	52.3%
Surgery of the tongue base	25–77%
UPPP unselected	40.7%
Nasal surgery	<20%

LAUP = laser-assisted uvulapalatoplasty; UPPP = uvulopalatopharyngoplasty.

Based on these somewhat sobering results, the question arises as to whether nasal surgery is still justified as a viable option in OSA therapy. However, the efficacy of nasal surgery in patients who will have to undergo nCPAP therapy is indisputable. It has been sufficiently proven that the postoperatively required nasal CPAP pressure can be substantially decreased by nasal surgery.[30]

CONCLUSION

It should be stated that nasal surgery cannot be generally recommended as first-choice therapy for OSA. When compared with other surgical methods, the success rate is too low with a value below 20% (see Table IV).[31–33]

Nevertheless, there seems to be a small proportion of patients who do respond to nasal surgery, but there are no reliable criteria for the preoperative identification of those patients.

Independent of the AHI, nasal surgery significantly improves daytime sleepiness and sleep quality of patients with sleep-related breathing disorders. Moreover, nasal surgery remains a valuable intervention for patients who will have to undergo a nasal CPAP therapy.

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