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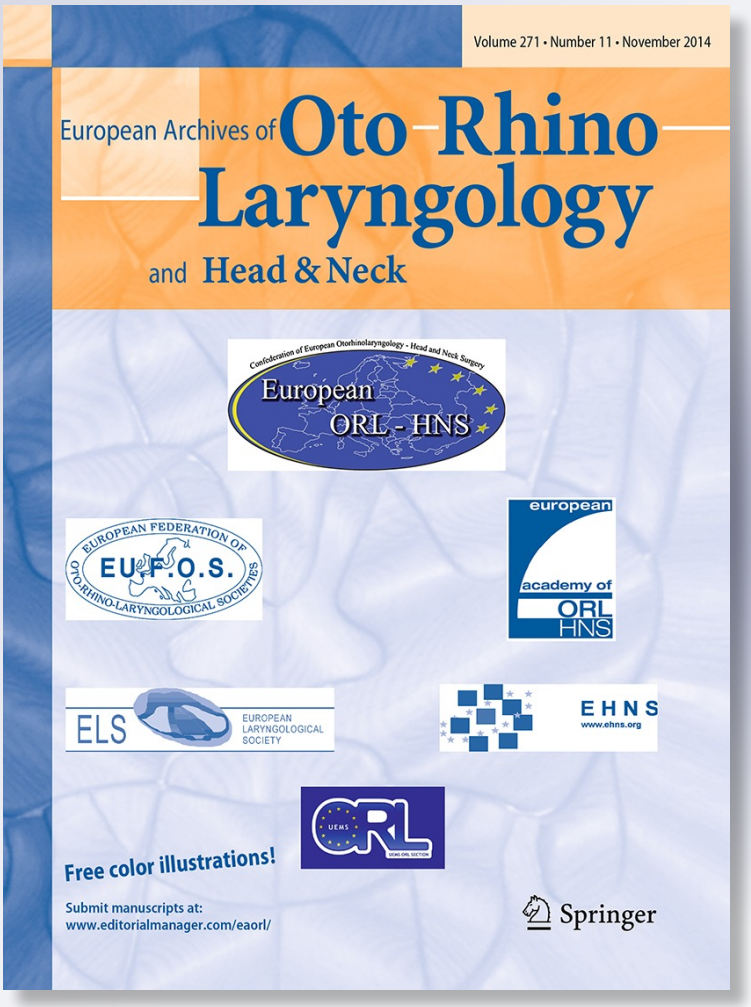
**European Archives of Oto-Rhino-Laryngology**
and Head & Neck

ISSN 0937-4477
Volume 271
Number 11

Eur Arch Otorhinolaryngol (2014)
271:2969-2974
DOI 10.1007/s00405-014-2990-x

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RHINOLOGY

# Histopathological changes in nasal mucosa with nasal septum deviation

**Tawakir Kamani · Taner Yılmaz · Selçuk Sürücü · Münir Demir Bajin · Rıza Önder Günaydın · Oğuz Kuşçu**

Received: 27 December 2013 / Accepted: 27 February 2014 / Published online: 20 March 2014
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**Abstract** Histopathological changes in septal and nasal mucosa of patients with nasal septum deviation are not well known. Biopsies of septal and lateral nasal mucosae from both sides of nose were obtained from 20 patients undergoing septoplasty and control group of 10 patients undergoing head and neck surgery. Histopathological changes including lymphocytic infiltration and squamous metaplasia were compared. This study determined significantly higher rate of squamous metaplasia and lymphocytic infiltration in septal mucosa opposite the deviation compared to control group. Furthermore, there was a significantly higher rate of lymphocytic infiltration in the lateral nasal wall mucosa opposite the deviation when compared to control group. Increased lymphocytic infiltration and squamous metaplasia are observed on both sides of nasal mucosa; however, they are more severe on the side opposite the deviation. Septal deviation predisposes to chronic mucosal inflammation and squamous metaplasia, both of which may render patients susceptible to chronic rhinosinusitis.

**Keywords** Nasal septum · Microscopy · Polarization · Nasal mucosa · Turbinates · Nasal obstruction

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## Introduction

A deviated nasal septum is the most frequent cause of surgically correctable nasal obstruction. In addition to persistent nasal obstruction, nasal septal deviation leads to pseudoxerostomia secondary to mouth breathing, increased incidence of sinusitis, snoring and external nasal deformities. The severity, location and shape of nasal septal deviation all influence the airflow dynamics of the nasal cavity [1]. In response to changes in airflow dynamics, compensatory hypertrophy of the mucosa of the lateral nasal wall opposite the side of deviation, ostiomeatal complex obstruction, and impaired mucociliary clearance are often found [2].

We could find only one study in medical literature which investigated the histopathology of nasal mucosa in patients with septal deviation [3]. Jang et al. [3] determined increased inflammatory cell infiltration and decreased glandular acini on the concave side of septal mucosa compared to the control group. Our study now extended this by including both the septal and lateral nasal walls of patients with impacted deviation, and compared those findings with a normal control population. We also investigated the presence of squamous metaplasia in septal and lateral nasal wall mucosa.

## Materials and methods

This study was approved by the institutional research ethics committee and was, therefore, performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All patients gave their informed consent prior to their inclusion in the study.

We studied two groups of patients: 20 patients (4 women and 16 men) between 15 and 40 years of age undergoing

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septoplasty for deviated nasal septum, and a control group of 10 patients (3 women and 7 men) without nasal pathology who were undergoing head and neck surgery and consented to biopsy. They were between 19 and 40 years of age.

Inclusion criteria were as follows:

Study group:

- consecutive patients with an impacted nasal septum on anterior rhinoscopy,
- and a difference of >0.2 $cm^2$ minimal cross-sectional area between the two nasal passages on acoustic rhinometry.

Control group:

- Straight nasal septum,
- and a normal nasal endoscopic evaluation,
- and a difference of <0.2 $cm^2$ minimal cross-sectional area between the two nasal passages on acoustic rhinometry.

Patients were excluded if they had any of the following:

- Ever smoked,
- an upper respiratory tract infection or sinusitis in the previous 2 months,
- an abnormal sinus X-ray characterized by lack of mucosal thickening, or sinus opacification, or air-fluid level,
- positive skin prick testing, using 20 of the most common inhalant allergens (defined as a wheal size >2 mm diameter and/or an area >25 % of the histamine reference).

Biopsy samples of mucosa of $\leq$0.05 $cm^2$ were obtained from the following sites:

Study group (during septoplasty):

- Septum at the most deviated point on the side of the deviation,
- the corresponding site on the side opposite the deviation,
- both inferior turbinates 2 cm from the anterior end.

Control group of 10 patients undergoing head and neck surgery:

- One side of the septum,
- corresponding inferior turbinate 2 cm from the anterior end.

Septal perforation was prevented by placing a cartilage graft between the two septal mucosal flaps and one or both sides of the mucosae were sutured. The biopsies obtained were placed in formaldehyde. They were then fixed on paraffin blocks and cut into 3 μm slices to be later stained with hematoxylin–eosin.

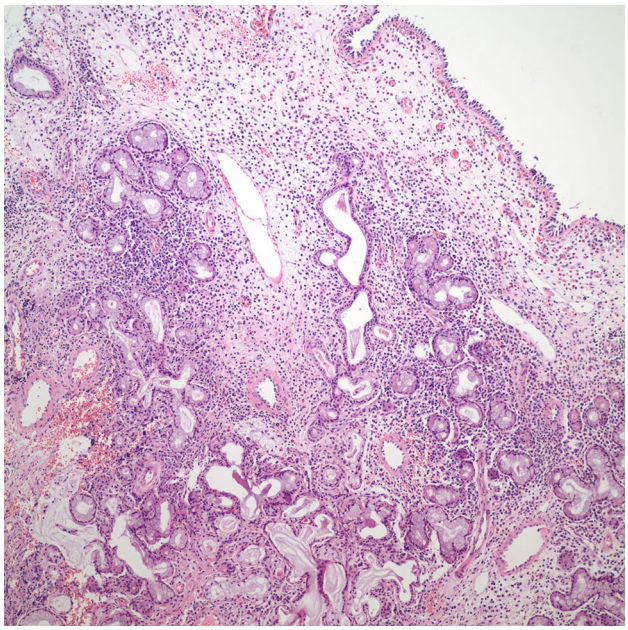

**Fig. 1** Nasal mucosa with severe (Grade 3) inflammation (H&E, ×120)

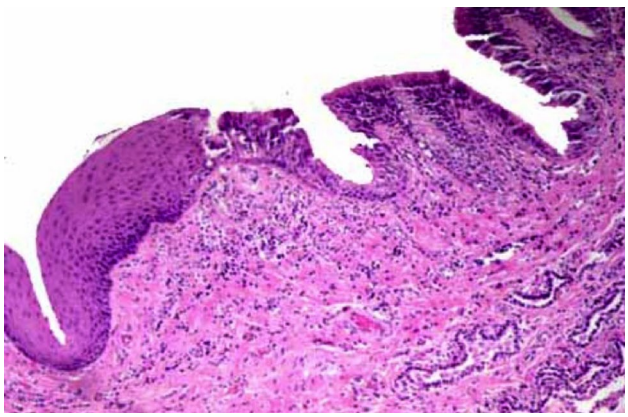

**Fig. 2** Presence of squamous metaplasia in nasal mucosa (H&E, ×120)

They were observed at 40× magnification power under a light microscope. The density of lymphocytic infiltration was graded by the pathologist as:

Grade 0: no lymphocytes
Grade 1: 1–2 lymphocytes in the field
Grade 2: sparse lymphocytes in all areas
Grade 3: diffuse and intense lymphocytic infiltration (Fig. 1)

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**Table 1** The comparison of squamous metaplasia rate on the deviated and opposite side of septal mucosa and lateral nasal wall mucosa in the study group and the control group (Chi-square test and Fisher's exact Chi-square test)

| | Squamous metaplasia | Normal epithelium | Statistics |
|---|---|---|---|
| Deviated side of septal mucosa ($n = 20$) | 8 | 12 | $\chi^2 = 2.857, p = 0.091$ |
| Control group ($n = 10$) | 1 | 9 | |
| Deviated side lateral nasal wall mucosa ($n = 20$) | 3 | 17 | $p = 1.000$ |
| Control group ($n = 10$) | 2 | 8 | |
| Septal mucosa opposite the deviated side ($n = 20$) | 10 | 10 | $\chi^2 = 4.593, p = 0.032$* |
| Control group ($n = 10$) | 1 | 9 | |
| Lateral nasal wall mucosa opposite the deviated side | 5 | 15 | $\chi^2 = 0.93, p = 0.760$ |
| Control group ($n = 10$) | 2 | 8 | |

* Statistically significant

Presence or absence of squamous metaplasia was also established (Fig. 2).

The mucosae of the study group were compared to those obtained from the corresponding sites (lateral wall and nasal septum) of the control group. Mucosae of corresponding sites were compared within the study group as well.

## Results

The rate of squamous metaplasia on the deviated side of septal mucosa in the study group was not significantly different from that of the control group (Chi-square test; $\chi^2 = 2.857$, $p = 0.091$) (Table 1). However, there was higher rate of squamous metaplasia in the study group (septal deviation group).

The rate of squamous metaplasia on the deviated side of lateral nasal wall mucosa in the study group was not significantly different from that of the control group (Fisher's exact Chi-square test; $p = 1.000$) (Table 1).

The rate of squamous metaplasia on the septal mucosa opposite the deviated side was statistically significantly different from that of the control group (Chi-square test; $\chi^2 = 4.593, p = 0.032$) (Table 1).

The rate of squamous metaplasia on the lateral nasal wall mucosa of the side opposite to deviation in the study group was not significantly different from that of the control group (Chi-square test; $\chi^2 = 0.93, p = 0.760$) (Table 1).

The rate of squamous metaplasia on the deviated side of septal mucosa was not significantly different from that of the septal mucosa opposite the deviated side in the study group (McNemar test, $p = 0.754$) (Table 2).

The rate of squamous metaplasia on the deviated side of lateral nasal wall mucosa was not significantly different from that of the lateral nasal wall mucosa opposite the deviated side in the study group (McNemar test, $p = 0.687$) (Table 3).

**Table 2** The comparison of rate of squamous metaplasia between septal mucosa on the deviated side and opposite side in the study group (McNemar test)

| | | Septal mucosa opposite the deviated side | | |
|---|---|---|---|---|
| | | Normal | Squamous metaplasia | |
| Septal mucosa on the deviated side | Normal | 6 | 6 | $p = 0.754$ |
| | Squamous metaplasia | 4 | 4 | |
| | Total ($n = 20$) | 10 | 10 | |

**Table 3** The comparison of rate of squamous metaplasia between lateral nasal wall on the deviated side and that on the side opposite the deviation in study group (McNemar test)

| | | Lateral nasal wall mucosa on the side opposite the deviation | | |
|---|---|---|---|---|
| | | Normal | Squamous metaplasia | |
| Lateral nasal wall mucosa on the deviated side | Normal | 13 | 4 | $p = 0.687$ |
| | Squamous metaplasia | 2 | 1 | |

The rate of lymphocytic infiltration on the deviated side of septal mucosa in the study group was not significantly different from that of the control group (Chi-square test; $\chi^2 = 5.585$, $p = 0.061$) (Table 4). However, there was higher rate of lymphocytic infiltration in the study group (septal deviation group).

The rate of lymphocytic infiltration on the deviated side of lateral nasal wall mucosa in the study group was not significantly different from that of the control group (Chi-square test; $\chi^2 = 1.971, p = 0.578$) (Table 4).

The rate of lymphocytic infiltration on the septal mucosa opposite the deviated side was statistically significantly

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**Table 4** The comparison of lymphocytic infiltration rate on the deviated and opposite side of septal mucosa and lateral nasal wall mucosa in the study group and the control group (Chi-square test and Fisher's exact Chi-square test)

| | Lymphocyte infiltration | | | | Statistics |
|---|---|---|---|---|---|
| | Grade 0 | Grade 1 | Grade 2 | Grade 3 | |
| Deviated side of septal mucosa ($n = 20$) | 7 | 11 | 2 | | $\chi^2 = 5.585$, $p = 0.061$ |
| Control group ($n = 10$) | 8 | 2 | 0 | | |
| Deviated side lateral nasal wall ($n = 20$) | 12 | 5 | 2 | 1 | $\chi^2 = 1.971$, $p = 0.578$ |
| Control group ($n = 10$) | 8 | 2 | 0 | 0 | |
| Septal mucosa opposite the deviated side ($n = 20$)[a] | 6 | 6 | 7 | 1 | $\chi^2 = 5.455$, $p = 0.02$* |
| Control group ($n = 10$) | 8 | 2 | 0 | 0 | |
| Lateral nasal wall mucosa opposite the deviated side[a] | 9 | 5 | 5 | 1 | $\chi^2 = 3.75$, $p = 0.05$* |
| Control group ($n = 10$) | 8 | 2 | 0 | 0 | |

* Statistically significant

[a] Because numbers in cells were small, statistical analysis was done by combining Grade 0 with Grade 1 and Grade 2 with Grade 3

**Table 5** The comparison of rate of lymphocytic infiltration between septal mucosa on the deviated side and opposite side in the study group (McNemar test)

| Lymphocytic infiltration in septal mucosa on deviated side[a] | Lymphocytic infiltration in septal mucosa opposite the deviation[a] | | | | |
|---|---|---|---|---|---|
| | Grade 0 | Grade 1 | Grade 2 | Grade 3 | |
| Grade 0 | 3 | 2 | 1 | 1 | $p = 0.07$ |
| Grade 1 | 2 | 4 | 5 | 0 | |
| Grade 2 | 1 | 0 | 1 | 0 | |
| Grade 3 | 0 | 0 | 0 | 0 | |

[a] Because numbers in cells were small, statistical analysis was done by combining Grade 0 with Grade 1 and Grade 2 with Grade 3

**Table 6** The comparison of rate of lymphocytic infiltration between lateral nasal wall on the deviated side and that on the side opposite the deviation in study group (McNemar test)

| Lymphocytic infiltration in lateral nasal wall on deviated side | Lymphocytic infiltration in lateral nasal wall on the side opposite the deviation | | | | |
|---|---|---|---|---|---|
| | Grade 0 | Grade 1 | Grade 2 | Grade 3 | |
| Grade 0 | 7 | 3 | 2 | 0 | $p = 0.267$ |
| Grade 1 | 2 | 0 | 3 | 0 | |
| Grade 2 | 0 | 1 | 0 | 1 | |
| Grade 3 | 0 | 1 | 0 | 0 | |

different from that of the control group (Chi-square test; $\chi^2 = 5.455$, $p = 0.02$) (Table 4).

The rate of lymphocytic infiltration on the lateral nasal wall mucosa of the side opposite to deviation in the study group was significantly different from that of the control group (Chi-square test; $\chi^2 = 3.750$, $p = 0.05$) (Table 4).

The rate of lymphocytic infiltration on the deviated side of septal mucosa was not significantly different from that of the septal mucosa opposite the deviated side in the study group (McNemar test, $p = 0.07$) (Table 5). There was a tendency toward increased lymphocytic infiltration on the side of septal mucosa opposite the deviation, which did not reach statistical significance.

The rate of lymphocytic infiltration on the deviated side of lateral nasal wall mucosa was not significantly different from that of the lateral nasal wall mucosa opposite the deviated side in the study group (McNemar test, $p = 0.267$) (Table 6).

## Discussion

The degree, localization and shape of deviation of the nasal septum affect dynamic airflow in the nasal cavity. There is a difference in the flow of, amount of, and resistance to, airflow in the nasal cavity of a patient with nasal septal deviation [1]. This difference is associated with compensatory hypertrophy of the nasal mucosa on the side opposite the deviation [4, 5]. In addition, an increased incidence of sinusitis, osteomeatal complex obstruction and mucociliary dysfunction have been reported [6–9]. However, Berger et al. [10] reported in their study hypertrophic lower turbinates opposite the septal deviation that the inferior turbinate bone manifested the most significant expansion, whereas the contribution of the mucosal layers to the inferior turbinate hypertrophy was modest. They also showed that apparently larger proportion of venous sinusoids in hypertrophic turbinates made a small difference, which was not statistically significant. They further found normal mucosal architecture in all inferior turbinates with compensatory hypertrophy with most remaining intact and few disclosing mild to moderate pathological changes.

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The ostiomeatal obstruction and resultant sinusitis on the side of the deviation are believed to be a direct result of the deviation, whereas changes on the side opposite to the deviation are thought to be due to abnormalities of the middle turbinate and lateral nasal wall [7]. Elahi et al. [7] indicated that ostiomeatal complex obstruction in the direction of septal angulation was attributable to nasal septal deformity; however, contralateral ostiomeatal complex obstruction was related to middle turbinate and lateral nasal wall abnormalities, which appeared with increased frequency on the side opposite to the septal deviation. Our study also determined significantly higher rate of squamous metaplasia and lymphocytic infiltration in septal mucosa opposite the deviation side compared to control group. Furthermore, there was a significantly higher rate of lymphocytic infiltration in the lateral nasal wall mucosa opposite the deviation when compared to control group. There was increased squamous metaplasia and lymphocytic infiltration in the septal mucosa on the deviated side; however, these could not reach statistical significance ($p = 0.09$ and $p = 0.06$, respectively). When both sides of deviated septal mucosa were compared to each other in terms of lymphocytic infiltration, there was a tendency toward increased lymphocytic infiltration in septal mucosa opposite the deviation compared to deviation side; however, this again did not reach statistical significance ($p = 0.07$).

Mucociliary activity is one of the basic factors affecting normal nasal function. Mucociliary dysfunction is a factor contributing toward rhinosinusitis. Previous studies have demonstrated that the mucociliary clearance time is significantly longer on the side opposite to the deviation when compared to normal controls. Polat and Dostbil [11] concluded that the septoplasty operation improved reduced nasal mucociliary transport rates after surgery, and that the effect of nasal surgery on nasal mucociliary activity might be more accurately evaluated in the third month than the first month of post-operative period.

Jang et al. [3] demonstrated significantly increased lymphocytic infiltration and decreased glandular acini of the septal mucosa of the side opposite to the deviation (the concave side) in comparison to that of the convex side. However, they obtained tissue specimen 2 cm posterior to nostril and 1.5 cm inferior to nasal dorsum; our specimen was taken from the most deviated side of septum and its opposite side. Thus, our specimens may more markedly show the effect of septal deviation on histopathology, compared to theirs. Our results support their finding, though without statistical significance, and in addition demonstrate that this lymphocytic infiltration on the side opposite the deviation is increased when compared with normal controls. Unfortunately, we did not evaluate glandular structures.

Septal deviation results in constant inflammation of the nasal mucosa and development of epithelial metaplasia. Epithelial metaplasia is a known association of chronic sinusitis [12, 13]. The interphase between respiratory and squamous epithelium is cuboidal epithelium at which stage ciliogenesis is still present. In the context of disturbed airflow dynamics, similar changes have been observed regarding epithelial metaplasia. Our study investigated the presence of squamous metaplasia. There is a significant increase in squamous metaplasia in the mucosa of septum on the side opposite to the deviation in the study group when compared to controls. There is also an increase in squamous metaplasia on the deviated side of nasal septum compared to controls; however, this did not reach statistical significance ($p = 0.09$); thus supporting previous observations that the side opposite the deviation is more affected [3, 8].

Squamous metaplasia was not significantly increased in the lateral nasal wall mucosae in septal deviation when compared to controls. Furthermore, squamous metaplasia was found to be similar in septal and lateral nasal wall mucosae on both sides of septal deviation.

We believe that the distribution of change of these functional and structural features is complex. One can postulate that there will also be variations in the timing of onset and progression of these changes. Hence treatment, including surgery to correct the macroscopic deformity, might have different success rates dependent on its timing relative to the course of these complex functional and microscopic structural changes.

As a conclusion, in addition to the disturbed mucociliary dysfunction that results from the altered airflow dynamics in the nasal mucosa of patients with septal deviation, histopathological changes also occur. Although such changes influence both sides of the nasal mucosa, they have been found to be more severe on the side opposite the deviation. Septal deviation predisposes to chronic mucosal inflammation and squamous metaplasia, both of which may render such patients susceptible to chronic rhinosinusitis.

**Acknowledgments** This study was totally financially supported by Hacettepe University Research Fund.

**Conflict of interest** The authors declare that they have no conflict of interest.

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