

# Transformation of the maxillary bone in adults with nasal polyposis: a CT morphometric study

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## PURPOSE

Nasal polyposis (NP) in adult population is a common problem in otorhinolaryngology outpatient practice. Computed tomography (CT) is the ideal imaging method to investigate paranasal sinus diseases. There is yet no study in the literature measuring the morphometry of maxillary bone in NP. The objectives of this study are to correlate the airway variables obtained by CT findings of both chronic nasal airway obstruction and control group in an adult population, and to investigate whether the bony structure of the airway is affected or not.

## MATERIALS AND METHODS

Forty NP cases that were followed up for 1–5 years by an otorhinolaryngologist were included in this retrospective study. Forty subjects who had normal findings reported on paranasal CT scans were randomly selected from our CT database as the control group. Maxillary and palatine bones (PB) were evaluated: the plane angle between the maxillary alveolar processes (MAP) and PB, and depth of the maxillary arch of both groups were compared.

## RESULTS

The mean angle between MAP and PB plane was wider in the NP group (right  $128.1 \pm 8.5^\circ$  and left  $126.2 \pm 8.5^\circ$ ) than control group (right  $106.6 \pm 8.1^\circ$  and left  $105.5 \pm 7.3^\circ$ ). The mean depth of maxillary arch was significantly smaller in the NP group ( $1.2 \pm 0.2$  cm) than in the control group ( $1.4 \pm 0.2$  cm).

## CONCLUSION

There could be a relationship between nasal polyposis in adults and maxillary shape. The flattening and shallowing of the maxillary arch detected in patients with NP may indicate that the bony structural changes continue in adulthood.

*Key words:* • nasal polyps • nasal obstruction • computed tomography

Chronic nasal obstruction is a common complaint in otorhinolaryngology outpatient practice (1, 2). Causes of nasal obstruction, conditioning mouth breathing, include nasoseptal deviation, hypertrophied lower turbinates, adenoids and tonsils, chronic or especially allergic rhinitis, nasal trauma, congenital nasal deformities, foreign bodies, nasal polyps, and tumors (3). One of the most common causes of nasal obstruction in adults is nasal polyposis (NP) (1, 2). Computed tomography (CT) is the ideal imaging method to investigate nasal and paranasal sinus diseases (4, 5).

In paranasal sinus CT scans, we have recently observed that the plane angle between the maxillary alveolar process (MAP) and palatine bone (PB) is increased and the depth of maxillary arch is decreased in many cases with NP.

Pediatric orthodontics literature concerning how nasal obstruction relates to dentofacial development is extensive and whether a cause-effect relationship exists has been debated for over a century (6–8). Although recent studies suggest a relationship between chronic nasal obstruction and dentofacial deformities, many questions remain unanswered (9, 10). However, there is very limited data on the morphometry of the maxillary arch in adults with nasal obstruction.

The objectives of the present study are to correlate the airway variables obtained by paranasal sinus CT findings of both patients with chronic nasal airway obstruction and a control group in adult population, and to investigate whether the bony structure of the airway is affected or not.

## Materials and methods

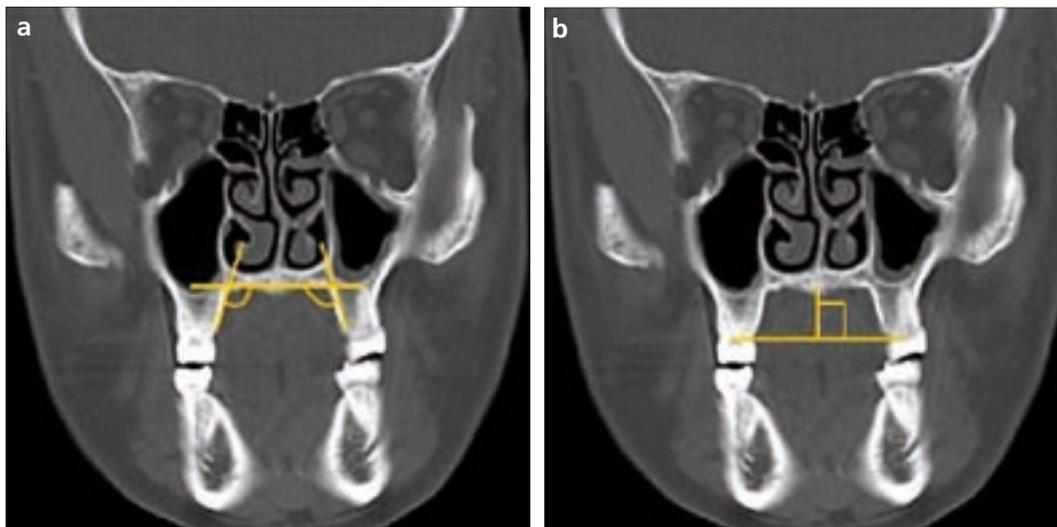
Forty NP cases that were followed up by an otorhinolaryngologist at least for 1 year were included in this retrospective study. The control group consisted of 40 subjects that were randomly selected from our CT database. Control subjects had normal findings or trivial pathologies, which did not cause any nasal airway obstruction (e.g., minimal mucosal thickening, small retention cyst) reported in paranasal CT scans. Both groups were similar regarding the age and weight. The diagnosis of NP was established by direct visualization via nasal endoscopy.

Paranasal sinus CT scans of all subjects were performed with the same parameters. A single slice spiral unit (Siemens Emotion, Siemens, Erlangen, Germany) was used for imaging. Unenhanced, 3 mm thick coronal and axial contiguous slices (pitch, 1.5) were obtained in the prone position with the head hyperextended. Although images were originally obtained with soft tissue and bone windows, we made the calculations on a single set of images obtained in the bone algorithm (window width, 2000–3000; window level, 400–760). The maxillary and palatine bones were evaluated on coronal images. The plane angle between MAP and

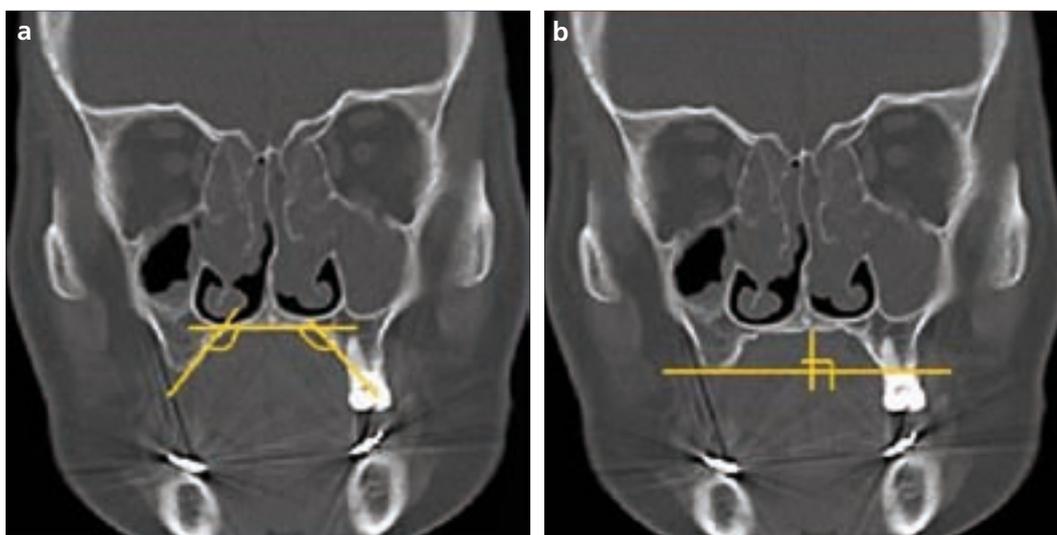
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Received 11 June 2009; revision requested 31 July 2009; revision received 13 August 2009; accepted 17 August 2009.

Published online 28 December 2009  
DOI 10.4261/1305-3825.DIR.2895-09.2



**Figure 1.** a, b. Lines demonstrate the calculation of the plane angle between the maxillary alveolar process and palatine bone (a), and the depth of maxillary arch (b).



**Figure 2.** a, b. Bilateral angles (right and left) between the maxillary alveolar process and palatine bone in nasal polyposis patients are significantly increased (a), and the depth of maxillary arch is shallow (b).

PB, and the depth of maxillary arch of both groups were compared. (Fig. 1).

Severe nasal polyposis cases presenting with nasal obstruction were included in the study in order to ob-

tain a homogeneous group. Less severe cases without nasal obstruction were excluded.

Statistical analyses were performed with SPSS for Windows (SPSS version

13.0, Chicago, Illinois, USA). The comparison of means of variables between both groups was performed using the independent t-test.  $P < 0.05$  was considered as significant.

## Results

The mean ages, male/female ratios, mean values of right and left angles between MAP and PB, and mean depths of maxillary arch for NP and control groups are summarized in Table. There were no statistically significant differences regarding the mean age and male/female ratio in both groups. Bilateral angles (right and left) between MAP and PB in NP group were significantly greater than those of control group ( $P < 0.001$ ), while there was a significant difference in favor of control group regarding the depth of maxillary arch ( $P < 0.001$ ) (Fig. 2).

**Table.** Comparison of the measured morphometric parameters of the maxillary bone in both groups

	NP group (n=40)	Control group (n=40)	P value <sup>a</sup>
Mean age $\pm$ SD	36.2 $\pm$ 4.6	38.5 $\pm$ 7.1	NS
M/F	18/22	21/19	NS
MAP-PB angle (right) $\pm$ SD (range)	128.1 $\pm$ 8.5 (109–150)	106.6 $\pm$ 8.1 (89–119)	<0.001
MAP-PB angle (left) $\pm$ SD (range)	126.2 $\pm$ 8.5 (107–143)	105.5 $\pm$ 7.3 (91–128)	<0.001
Depth of the maxillary arch (cm) $\pm$ SD (range)	1.2 $\pm$ 0.2 (0.8–1.0)	1.4 $\pm$ 0.2 (1.0–2.6)	<0.001

NP, nasal polyposis; M/F, male/female; MAP, maxillary alveolar process; PB, palatine bone; NS, not significant.  
<sup>a</sup>Independent t-test

## Discussion

In adult population, chronic nasal obstruction, especially due to NP, is a common complaint in otorhinolaryngology outpatient practice (1, 2). NP is known to be associated with bronchial asthma and a number of topical and systemic diseases of different origins (11–13). The exact origin of NP is unknown. However, a variety of allergic, infectious, inflammatory, anatomic, and genetic factors are known to be involved as are autonomous dysfunction and ciliary, enzymatic, epithelial, and mucopolysaccharide abnormalities (12, 13). No single pathogenic factor has been shown to apply to all types of polyps, although the potential mechanisms may converge on a single pathway. Nasal polyps occur when the edematous lining of the nasal cavity becomes dependent, blocking it to a variable degree, and causes nasal obstruction. Polyps usually start around the ostiomeatal complex, but can be found throughout the nose and sinuses (1, 2). Our NP group consisted of moderate and severe cases with mostly complete nasal obstruction.

Bone remodeling of the paranasal sinuses can be affected by many factors including age, sex, chronic inflammation, and surgery (11). In our study group, obstruction due to NP might be the only causative factor for the obvious remodeling of the maxillary arch.

CT of the nose and paranasal sinuses is still the ideal imaging method to investigate nasal and paranasal sinus diseases with a high sensitivity because it provides precise information about soft and bony parts of the nasal cavity and paranasal sinuses (4, 5). In our study group, paranasal sinus CT scans were indicated to monitor polyp extension and evaluate underlying bony structures.

Although there is significant evidence that total or partial obstruction of nasal breathing results in mouth breathing, the latter's effect on dentofacial growth and development is still obscure (14–17). The best known reported topic is nasal obstruction due to adenoid hypertrophy in the early childhood causing dentofacial changes (15–18). Specifically, it has been stated that chronic nasal obstruction leads to mouth breathing, which causes altered tongue and man-

dible positions. If this occurs during a period of active growth, the outcome is development of the "adenoid face" (18). Such patients characteristically manifest a vertically long lower-third facial height, narrow alar bases, lip incompetence, a long and narrow maxillary arch, and a greater than normal mandible plane angle. These dentofacial traits have repeatedly been attributed to restricted nasorespiratory function. It is generally believed that environmental factors can exert subtle or dramatic effects upon dentofacial morphology, depending upon their magnitude, duration, and time of occurrence (16, 17, 19). It would appear that chronic nasal obstruction, not related to the adenoids (nasal septal deformity, chronic rhinitis, external nasal deformity, etc.), can lead to a similar elongated lower face. Various possible mechanisms were reported in order to explain the bony structural changes (16, 17). Nasal breathing can exert a dramatic effect upon the development of the dentofacial complex. Recent studies suggest a relationship between nasal obstruction and dentofacial deformities; however, many questions remain unanswered. According to Meredith, the growth of the face is completed at a relatively early age (6). Sixty percent of craniofacial development takes place during the first 4 years of life and 90% by age 12. The flattening and shallowing of the maxillary arch detected in our study group reveals that bony structural changes might continue in adulthood. Although it is a common belief that dentofacial developments expire in childhood, this may not be the case under some special conditions such as NP in adults. There is yet no study in the literature measuring the morphometry of maxillary bone in adult patients with NP. To the best of our knowledge, ours are likely the first morphometric measurements showing the remodeling of maxillary bone in adulthood. Further studies focusing on following up cases with nasal polyposis might explain this complex mechanism.

In conclusion, our morphometric study demonstrates that nasal polyposis causes maxillary bone remodeling in adult population; therefore the bony structural changes might be continuing in adulthood.

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