

# Types of ethmoid sinus morphology on the basis of computed tomography examination

Ingrid Różyło-Kalinowska<sup>1</sup>, Grzegorz Jędrzejewski<sup>1</sup>, Franciszek Burdan<sup>1, 2</sup>

<sup>1</sup>2<sup>nd</sup> Department of Radiology, Medical University, Lublin, Poland

<sup>2</sup>Department of Human Anatomy, Medical University, Lublin, Poland

[Received 29 May 2003; Revised 23 July 2003; Accepted 23 July 2003]

*The aim of the study was the application of computed tomography (CT) in the evaluation of types of ethmoid morphology. The material consisted of 197 CT examinations performed, using the Somatom AR.T (Siemens) CT scanner, in patients referred for CT for reasons other than sinus pathology. The examinations were performed in 2-mm contiguous axial scans. Ethmoid morphology was evaluated by means of classification into 3 types according to the degree of aeration and the relationship of the anterior ethmoid cells to the lacrimal sac on transversal scans. The most common was the II type (medium relationship to the lacrimal sac) found in 38.32% of the cases. Type III (large ethmoid sinus extending in front of the lacrimal sac) occurred in 32.49% of the patients, while the smallest sinus (Type I) was detected in the remaining 29.19% of the cases. In almost 1/5 of the cases asymmetry of the bilateral ethmoid anatomy was noted. It was concluded that CT examination was useful in the evaluation of ethmoid sinus morphology in respect to the lacrimal sac.*

**key words:** ethmoid sinus, computed tomography

## INTRODUCTION

The ethmoid sinus as an element of the paranasal sinus system is characterised by considerable individual variation. There are 3 to 17 cells per side [8]. Computed tomography (CT) has long been applied in the examination of paranasal sinuses, including ethmoid air cells [2, 3, 10].

The aim of the paper is an evaluation of the morphology of the ethmoid sinus in relationship to the lacrimal fossa on the basis of computed tomography studies.

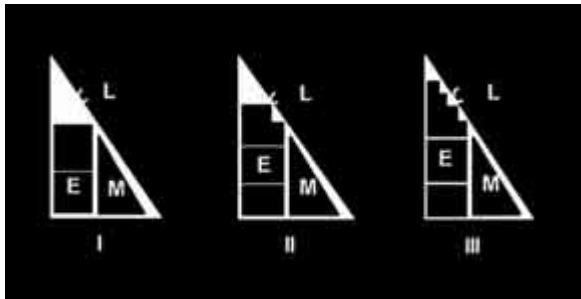
## MATERIAL AND METHODS

The material consisted of 197 CT examinations performed in the years 1995–2002 in the 2<sup>nd</sup> Department of Medical Radiology of the Medical University of Lublin by means of Somatom AR.T (Siemens, Erlangen, Germany) CT scanner. For the purpose of

this study Caucasian adult patients were qualified who had been referred for CT examinations due to initial diagnosis of ophthalmological lesions and who had no obvious pathology in the paranasal sinuses. The examinations were performed in 2-mm contiguous axial scans.

The relationship of the anterior ethmoid cells to the lacrimal fossa was defined on the axial images that were obtained of 394 ethmoid sinuses (Fig. 1). The sinuses were divided into 3 types: Type I — no ethmoid cells located anteriorly to the posterior lacrimal crest on transverse images (Fig. 2); Type II — ethmoid sinuses extend anteriorly to the posterior lacrimal crest but remain behind the suture at the anterior edge of the lacrimal bone (Fig. 3); Type III — anterior ethmoid cells exceed the level of the lacrimal bone suture (Fig. 4) [4, 5]. Bilateral symmetry of the ethmoid sinuses was also observed.

Address for correspondence: Ingrid Różyło-Kalinowska, MD, PhD, 2<sup>nd</sup> Department of Medical Radiology, Medical University, ul. Staszica 16, 20–081 Lublin, Poland, tel: +48 81 532 10 84, fax: +48 81 740 77 40, e-mail: ingrozylo@eskulap.am.lublin.pl



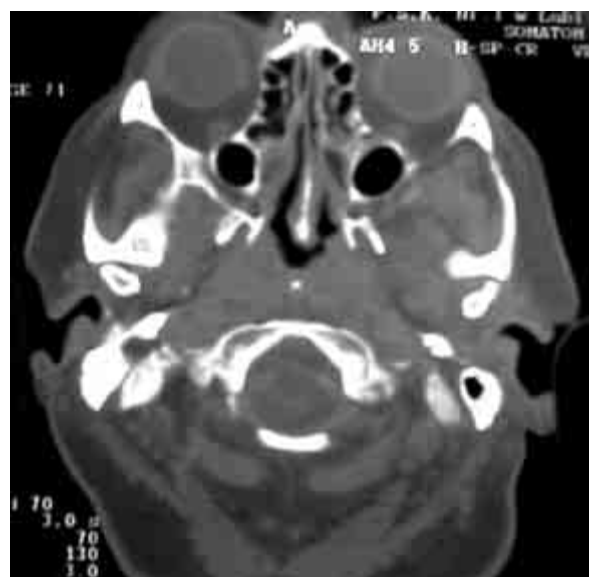
**Figure 1.** Schematic drawing of the relationship of the ethmoid sinuses to the lacrimal fossa; L — lacrimal fossa, E — ethmoid sinus, M — maxillary sinus.



**Figure 2.** CT image of Type I morphology of anterior ethmoid cells.



**Figure 3.** Axial CT scan presents Type II anatomy of the ethmoid sinus.



**Figure 4.** Type III ethmoid sinus visible on a CT scan.

## RESULTS

The most common type of ethmoid morphology was Type II, found in 38.32% of the cases. Type III occurred in 32.49% of the patients, while the smallest sinus (Type I) was detected in the remaining 29.19% of the cases. In 19.2% of the cases asymmetry of the bilateral ethmoid anatomy was noted. Most frequently Types II and III co-existed (34 persons), while simultaneous occurrences of Types I and II as well as Types I and III were both noted in 2 persons. No statistically significant correlation between the CT type of ethmoid sinus morphology and existing sinus inflammatory pathology was observed.

## DISCUSSION

Knowledge of the individual anatomy of the ethmoid sinuses is indispensable in patients referred for surgical procedures and interventions in the of the lacrimal sac and nasolacrimal duct system in order to avoid the possibility of entry into an ethmoid sinus while performing the procedure [2, 5, 6, 11]. Initial entry into the ethmoid sinuses during dacryocystorhinostomy is assessed as reaching 46% [11].

In a Chinese study of the anatomical relationship between the anterior ethmoid and the fossa of the lacrimal sac in 16 adult cadavers Type I accounted for 31.2%, Type II for 50% and Type III for 18.8% of the cases [3]. According to a Korean series of 53 persons (106 lacrimal fossas) 6.6% presented Type I, the majority (71.7%) qualified as Type II, and the remaining 21.7% were accounted for by Type III eth-

moid morphology [2]. In the present material the differences between the types were less marked. According to some authors the interposition of the anterior ethmoid air cells between the lacrimal sac and the nasal cavity occurs frequently in the Western the population (up to 41%) [1]. However, a comparative study of Western and Asian adult patients demonstrated the anterior extension to the lacrimal sac in 22% and 45% respectively and the difference was statistically significant [9]. Asymmetry of the position of the air cells was noted in 22.6% of cases according to Cho et al. [4] and these findings were similar to our own observations (19.2%).

In the material examined in this study no statistically significant correlation was observed between the CT type of ethmoid sinus morphology and existing sinus inflammatory pathology. However, it is evident that the anterior ethmoid plays an essential role in the pathogenesis of the paranasal sinuses diseases, as any disease changes in this area usually cause obstruction in the ventilation of the maxillary and frontal sinuses [7].

On the basis of the results obtained it may be concluded that CT examination was useful in the evaluation of ethmoid sinus morphology in respect to the lacrimal fossa. The CT assessment of ethmoid morphology types greatly aids in the planning and performance of lacrimal system surgical procedures.

## REFERENCES

1. Blaylock WK, Moore CA, Linberg JV (1990) Anterior ethmoid anatomy facilitates dacryocystorhinostomy. *Arch Ophthalmol*, 108: 1774–1777.
2. Bogusławska-Staniaszczyk R, Krzeski A, Mastalerski J (1994) Anatomia radiologiczna zatok przynosowych dla potrzeb chirurgii endoskopowej. *Pol Przegl Radiol*, 58: 109–113.
3. Bogusławska-Staniaszczyk R, Krzeski A, Samoliński B (1994) Przydatność badań tomograficzno-komputerowych dla celów endoskopowej chirurgii nosa i zatok przynosowych. *Otolaryngol Pol*, 48 (Suppl. 17): 63–75.
4. Cho KR, Seol HY, Kim SH, Kang EY, Park EM, Cha IH (2000) Anatomical relationship between lacrimal fossa and anterior ethmoidal sinus on high resolution CT. *Eur Radiol*, 10 (Suppl. 1): 142.
5. Jiang M, Zhang S, Li Z (1999) Applied anatomy of anterior ethmoid relevant to endoscopic transnasal dacryocystorhinostomy. *Lin Chuang Er Bi Yan Hou Ke Za Zhi (Chinese)*, 13: 497–498.
6. Krzeski A, Chęciński P, Samoliński B (1994) Anatomia topograficzna nosa i zatok przynosowych dla potrzeb chirurgii endoskopowej. *Otolaryngol Pol*, 48 (Suppl. 17): 57–62.
7. Krzeski A, Goździk-Żołnierkiewicz T (1994) Rola sitowia przedniego w patogenezie zapaleń zatok przynosowych. *Otolaryngol Pol*, 48 (Suppl. 17): 76–82.
8. Krzeski A, Tomaszewska E (2000) Boczna ściana jamy nosowej. *Via Medica*, Gdańsk.
9. Shin JC (1999) Comparative lacrimal sac and ethmoid anatomy in Asian and Western adult Patients. <http://eyedoctor.snu.ac.kr/sem9921.html> (accessed: 30.04.2003).
10. Som PM (1985) CT of the paranasal sinuses. *Neuroradiol*, 27: 189–201.
11. Talks SJ, Hopkinson B (1996) The frequency of entry into an ethmoidal sinus when performing a dacryocystorhinostomy. *Eye*, 10: 742–743.