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The ethmoid labyrinth: An anatomical and comparative radiological study

Carmen R. Guirado, Barcelona, Spain and
Francesco Bagatella, Ferrara, Italy

SUMMARY

After an osteologic description of the ethmoid labyrinth, the radiologic techniques which best display the ethmoidal cell topography, relationships and configuration are examined. On the basis of these observations it is concluded that standard radiographic tests cannot give a clear anatomic-radiologic representation of the ethmoid cells and that they must be supplemented with tomography.

INTRODUCTION

Few parts of the body are as anatomically variable as the various facial sinuses are. These sinuses differ in shape and size not only from individual to individual but even between the two sides of the same individual. Knowledge of these variations is useful for diagnostic orientation and even more so for surgical application. Even if rhinologic exploration by optical means has recently been expanded and perfected, the fundamental instrument of study, while awaiting wider use of computerized axial tomography, is still the radiographic examination.

Radiography permits the collection, in an atraumatic manner, of information both about the structural make-up and state of the sinus cavities. However, standard radiographic examinations do not clearly represent the anatomy of all sinus cavities; some of these, such as the ethmoid labyrinth, require further study.

The present study aims at elucidating the relationships between anatomy and radiology of the ethmoid labyrinth. It was conducted on 10 adult sinus specimens obtained using the technique described by Bagatella (1981). The various technical projections which best display the ethmoid cell topography, their relationships and configuration were studied. The various radiograms were then compared with the anatomic peculiarities emerging from dissection.

MATERIAL AND METHODS

Anatomical and radiological studies were performed in 10 adults' specimens. Be-

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fore dissection they were analyzed through various tomographic planes. In this presentation we describe one of the most interesting specimens for anatomical and comparative radiological study.

Tomographic technique

Tomography is a method for radiological study by means of sections which avoid overlapping the structures located either above or below the selected level.

For the present work, an spiral multidirectional tomograph (Stratomatic) was used, which makes possible highly clear views.

Lateral and frontal tomograms were obtained and also the Guillen frontal-oblique projection which allows sections according to the principal axis of the ethmoid bone (Figure 1).

Afterwards an anatomical dissection was done of the specimen, individualizing the diverse groupings of cells comprising the ethmoid labyrinth (Figure 2).

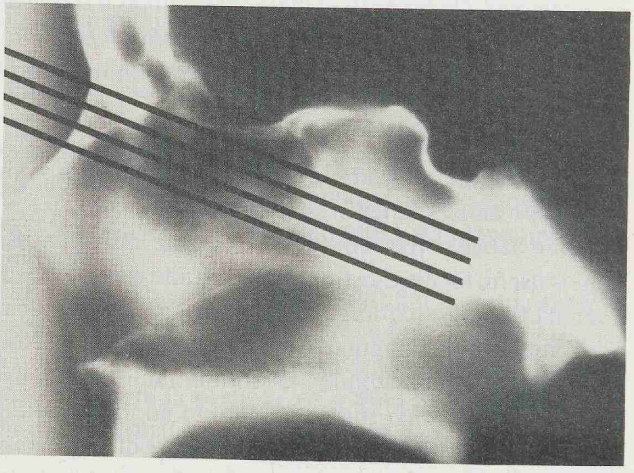

Figure 1.
Sections according to the frontal-oblique projection.

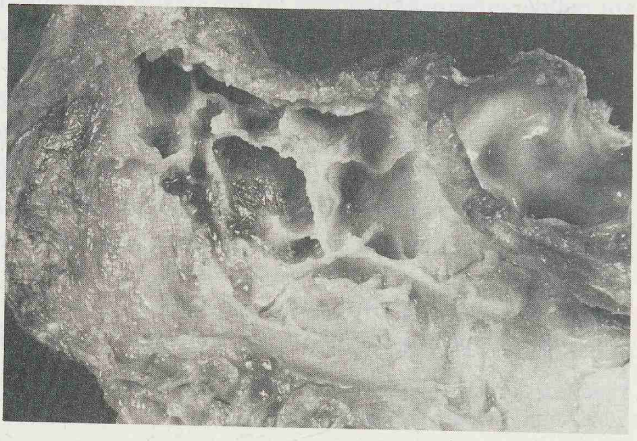

Figure 2.
Anatomical specimen of the ethmoid showing the different cells comprising the labyrinth.

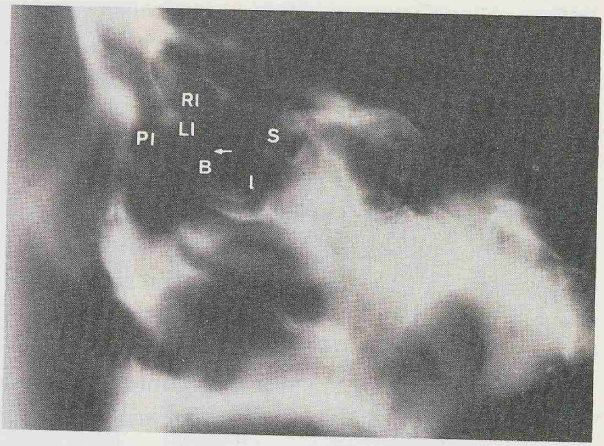

Figure 3.
Lateral tomographic section perfectly superimposed on the dissection of the specimen of Fig. 2, showing the groups of cells.
PI: Pre-infundibular cell.
LI: Lateral infundibular cell.
RI: Post-infundibular cell.
B: Bulla.
S: Superior cell of the posterior ethmoid.
I: Inferior cell of the posterior ethmoid.

RESULTS

We performed three different tomographic planes in the specimen:

1. Lateral tomographic view (OM = 0°). These coincide with the sagittal plane. This view of the ethmoid is very important and illustrative for better knowledge of the arrangement of various labyrinth cells. In the specimen in question, the tomographic plane could be perfectly superimposed on the dissection subsequently carried out revealing the different ethmoid cell groups and principal lamellas (Figure 3).

In the anterior ethmoid, first a preinfundibular, a lateral infundibular an then a post-infundibular cell are found. The bulla can be perfectly identified. Immediately behind the bulla we find the middle turbinate basilar lamina, which obliquely separates the anterior and posterior ethmoid.

The posterior ethmoid is just behind this bony lamina. In this specimen it is formed by two superimposed cells, the smaller occupying the upper plane and the larger in the lower plane demonstrating a more pronounced posterior extension. This two cells appear to be separated by a horizontal lamina whose direction coincides with that of the middle turbinate.

In spite of the great anatomical variations of the ethmoid, we must emphasize the permanence of four partition walls, dividing various groupings of the cells comprising the labyrinth and being always attached to the external wall of the nasal cavity. In 1922, Mouret described these particular walls, trying to establish a systematic way to study this sinus. The walls dividing the different groups are intimately connected to the bony lamellas belonging to the turbinates, according to Mouret's description.

We have been able to proof this research anatomically as well as radiographically. The ethmoidal turbinates themselves send osseous partition roots in an upward direction, that finally divide the cellular groups according to their drainage in the corresponding meatus (Figure 4).

2. Tomographic Frontal view (OM = − 25°). This view permits frontal study of the paranasal sinuses.

Beginning in the front, views were obtained at 0.5 cm intervals. The most anterior plane passes at the frontal sinus and preinfundibular cell. The following plane, in anteroposterior order, is of great interest since, in the same tomogram, it makes possible a superimposed view of cells belonging to distinct ethmoid cell groups. Specifically, the upper cell belongs to the posterior ethmoid and the lower cell to the bulla, which in turn is part of the anterior ethmoid (Figure 5). This simultaneous presence is due to the oblique arrangement from top to bottom of the middle turbinate lamella.

3. Frontal-Oblique tomographic view (OM = − 70°). This tomographic view was first introduced by Dulac (1954), specifically to study the nasal pyramid obtaining sections perpendicular to its dorsal direction. With this method very precise images are obtained of the skeleton of this region from the pre-maxillary to the cartilaginous and bony septum, as well as the turbinate area. However, it was Guillen (1976) who utilized this plane to study the ethmoid region obtaining important views including the frontal and sphenoidal regions and their relationships with the labyrinth. Guillen called this tomographic position the frontal-oblique projection. By means of this view, radiographic evaluation of the ethmoid is far superior to that which can be obtained with classical frontal sections previously described.

Figure 4.
Anatomical specimen of the ethmoid showing the dissection of the four partition roots dividing the different groupings of cells (according to Mouret).
From front to back:
1. The root of the uncinate process.
2. The root of the bulla.
3. The root of the middle turbinate.
4. The root of the superior turbinate.

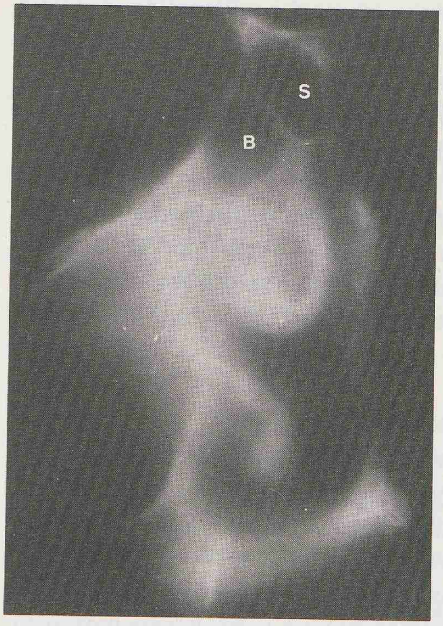

Figure 5. Frontal tomographic view of the specimen at the level of the boundary between the anterior and posterior ethmoid. The cell located on the upper (S) belongs to the posterior ethmoid, while the lower is the bulla (B).

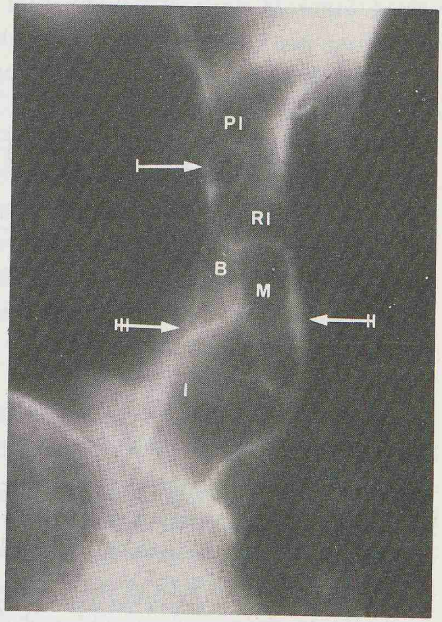

Figure 6. Tomographic view of the specimen following Guillen's frontal-oblique projection:
PI: Pre-infundibular cell.
RI: Post-infundibular cell.
B : Bulla
M: Middle meatus.
I : Inferior cell of the posterior ethmoid.
↦ Infundibular canal.
↦ Middle turbinate basilar lamina.
↦ Middle turbinate root.

In the tomographic plane shown in Figure 6, a frontal-oblique view of the specimen under examination is seen. This tomogram gives a section coinciding with the drainage axis of the ethmoid cells.

CONCLUSION

From the present study the conclusion is drawn that tomography is the most adequate radiologic procedure for the examination of the ethmoid labyrinth since it eliminates the overlapping of the nearby bony structures. Furthermore, the form and number of cells that make up both the anterior and posterior ethmoid are placed in greater relief by using both complementary tomographic projections: frontal-oblique and lateral. These two incidences give a very clear idea of what the situation is like in the different cell units and the bony lamellas which make

up the ethmoid sinus. Reconstruction of the ethmoid configuration, acquired from these two views, is of inquestionable value before any surgical approach to this difficult and complex anatomic region.

ZUSAMMENFASSUNG

Nach einer osteologischen Beschreibung des ethmoidalis Labyrinths prüfen die Autoren die Röntgentechniken, die besser die Topographie, die Verhältnisse und die Gestaltung der Siebbeinzellen hervorheben. Auf Grund Ihrer Beobachtungen schliessen Sie, dass die standard Röntgenbilder keine klare anatomisch-radiologische Darstellung der Siebbeinzellen geben können und diese durch Tomographie ergänzt werden sollen.

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Dr. Carmen R. Guirado
Instituto Radiologico Cabeza y Cuello
Muntaner 246–1°
Barcelona
Spain