

# The clinical value of temporal bone tomography in chronic otitis media

## Kronik otitis mediada temporal kemik tomografisinin klinik değeri

Cüneyt Kucur, M.D.,<sup>1</sup> Eda Şimşek, M.D.,<sup>3</sup> Ozan Kuduban, M.D.,<sup>3</sup> İrfan Çelebi, M.D.,<sup>2</sup> Ali Okan Gürsel, M.D.<sup>4</sup>

<sup>1</sup>Department of Otolaryngology, Medicine Faculty of Dumlupınar University, Kütahya, Turkey

<sup>2</sup>Department of Radiology, Şişli Etfal Training and Research Hospital, İstanbul, Turkey

<sup>3</sup>Department of Otolaryngology, Erzurum Regional Training Hospital, Erzurum, Turkey

<sup>4</sup>Department of Otolaryngology, Fatih Sultan Mehmet Training and Research Hospital, İstanbul, Turkey

**Objectives:** This study aims to investigate the indications, the results and the limits of preoperative computed tomography (CT) scanning in chronic otitis media (COM), and to evaluate the clinical contribution of CT in determining the nature and complications of the disease.

**Patients and Methods:** In this cross-sectional study, the results of preoperative CT with operative findings during mastoidectomy in 50 patients with COM (28 males, 22 females; mean age 34 years; range 16 to 69 years) between January 2008 and January 2010 were analyzed.

**Results:** Computed tomography was highly sensitive to the presence of soft tissue, mastoid pneumatization, dural height, and temporal bone destruction with nearly 100% sensitivity. Its contribution to detecting lateral canal fistulas, facial canal dehiscence, tegmen tympani erosion, and ossicular integrity was limited.

**Conclusion:** Preoperative assessment of COM with CT produce important guidance to evaluate the extent of the disease and to prevent possible intraoperative complications.

**Key Words:** Cholesteatoma; chronic otitis media; temporal bone; tomography.

**Amaç:** Bu çalışmada kronik otitis mediada (KOM) ameliyat öncesi bilgisayarlı tomografisinin (BT) endikasyonları, sonuçları ve sınırları araştırıldı ve hastalığın özellikleri ve komplikasyonlarının belirlenmesinde BT'nin klinik katkısı değerlendirildi.

**Hastalar ve Yöntemler:** Bu çapraz kesitsel çalışmada, Ocak 2008 - Ocak 2010 tarihleri arasında KOM'si olan 50 hastanın (28 erkek, 22 kadın; ort. yaş: 34; dağılım 16-69 yıl) ameliyat öncesi BT sonuçları mastoidektomi sırasındaki cerrahi bulgular ile birlikte incelendi.

**Bulgular:** Bilgisayarlı tomografi yumuşak doku, mastoid pnömonizasyonu, dural yükseklik ve temporal kemik yıkımı açısından, neredeyse %100 duyarlılık ile, yüksek düzeyde duyarlıydı. Lateral kanal fistüller, fasiyal kanal dehiscansı, tegmen timpani erozyonu ve ossiküler bütünlüğün saptanmasına sınırlı bir katkısı vardı.

**Sonuç:** Kronik otitis medianın ameliyat öncesi BT ile değerlendirilmesi, hastalığın derecesinin değerlendirilmesinde ve ameliyat sırasında oluşabilecek komplikasyonların önlenmesinde önemli bir kılavuzdur.

**Anahtar Sözcükler:** Kolesteatom; kronik otitis media; temporal kemik; tomografi.



Chronic otitis media (COM) is the term used to describe a variety of signs, symptoms, and physical findings that result from the long-term damage to the middle ear by infection and inflammation. Chronic otitis media can be divided into two subtypes: Chronic otitis media with cholesteatoma and chronic mucosal disease. Surgical treatment is mandatory in the cholesteatoma group because of the high risk for labyrinthine and cerebromeningeal complications. Chronic otitis media without cholesteatoma does not have an osteolytic potential, but may leave auditory sequelae that in selected cases may warrant surgical treatment to improve hearing. The differential diagnosis between these two subtypes therefore becomes a crucial challenge.<sup>[1]</sup> Although cholesteatoma diagnosis can be obtained through accurate otomicroscopy, most of the time radiological imaging is needed to understand the nature and extension of the disease and anatomic variants. High resolution computed tomography (CT) is presently the most accurate technique to study the temporal bone. Nevertheless, there is no general agreement about its usefulness in preoperative evaluation of chronic otitis media.<sup>[2]</sup>

The objective of the study is to specify the indications, the results and the limits of preoperative CT scanning in chronic otitis media, and to evaluate the clinical value of CT in determining the nature and complications of the disease.

#### PATIENTS AND METHODS

In this cross-sectional study, we reviewed 50 patients (28 males, 22 females; mean age 34 years; range 16 to 69 years) with chronic otitis media who underwent preoperative CT scanning and compared the CT scan results with intraoperative clinical findings during mastoidectomy between January 2008 and January 2010. Computed tomography scanning was performed without using intravenous contrast on a Siemens Somatom

Spirit Syngo CT 2006c Scanner using high resolution mode. Computed tomography images were obtained in coronal and axial planes using 1 mm slice thickness and 1 mm intersection gap. The scans were interpreted retrospectively and without clinical information by a single radiologist. We aimed to assess the sensitivity and specificity of CT in determining cholesteatoma, ossicular chain erosion, tegmen tympani erosion, temporal bone erosion, dehiscence of facial canal, and lateral semicircular canal (LSCC) fistula.

All the participants gave oral and written informed consent prior to the operation. The study was conducted according to the guidelines for clinical studies described in the Declaration of Helsinki (as revised by the World Medical Association, <http://www.wma.net>)

#### RESULTS

Computed tomography scans of 50 patients had a soft tissue mass that filled the middle ear cavity diffusely or located locally in the attic and/or antrum. Soft tissue was found in the middle ear or mastoid cavity in all of the cases during the operation, which means 100% consistency with the CT.

At surgery, cholesteatoma was present in 23 patients (46%). Computed tomography scan showed cholesteatoma in 20 of the patients (40%). Computed tomography correctly predicted cholesteatoma in 14 patients (%28), and correctly excluded cholesteatoma in 21 patients (42%) (Table 1). According to this data, the sensitivity of the scan to detect cholesteatoma is 60%, and the specificity is 77.7%.

Our results showed CT scan to be highly sensitive for mastoid pneumatization, dural height, and temporal bone destruction with nearly 100% sensitivity, moderately sensitive for lateral canal fistulas, facial canal dehiscence, tegmen tympani erosion, and least sensitive for ossicular integrity.

**Table 1.** Presence of cholesteatoma

Operation findings	CT findings		Total
	Cholesteatoma	No cholesteatoma	
Cholesteatoma	14	9	23
No cholesteatoma	6	21	27
Total	20	30	50

CT: Computed tomography.

**Table 2.** Predictive value of computed tomography scan

Assessed parameters in CT scan	True (+)		True (-)		False (+)		False (-)	
	n	%	n	%	n	%	n	%
Cholesteatoma presence	14	28	21	42	6	12	9	18
Lateral canal fistulas erosion	1	2	46	92	2	4	1	2
Facial canal dehiscences	3	6	41	82	4	8	2	4
Dural height	2	4	48	96	0	0	0	0
Dural exposure	4	8	43	86	1	2	2	4
Temporal bone destruction erosion	21	42	28	56	0	0	1	2
Malleus erosion	15	30	28	56	3	6	4	8
Inkus erosion	18	36	24	48	5	10	3	6
Stapes erosion	9	18	18	36	11	22	4	8
Mastoid pneumatization	48	96	0	0	2	4	0	0

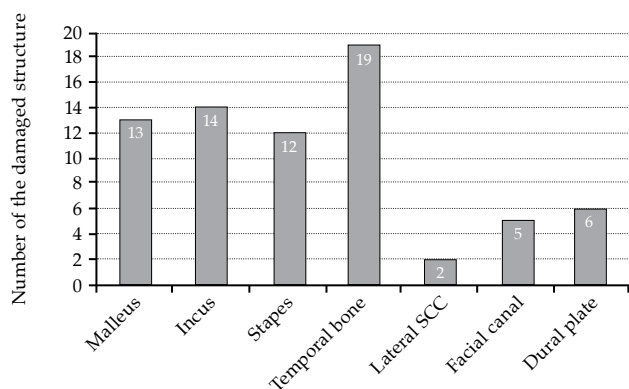
CT: Computed tomography.

It is relatively easy to visualize the bodies of the malleus and the incus on CT but this has little clinical value unless the integrity of the whole ossicular chain can be demonstrated. The detection of stapes erosion is especially difficult because of the small size of the structure and because cholesteatoma and inflammatory tissue in the middle ear obscure the stapes. Also in our series, CT showed an ability to correctly predict an intact ossicular chain in only 45% of cases (Table 2).

We observed cholesteatoma formation in all of patients having dural exposure, facial canal dehiscence, and LSCC fistulas. Moreover ossicular erosion and temporal bone destruction rates were significantly higher in cholesteatoma patients (Figure 1).

### DISCUSSION

Chronic otitis media is a potentially serious disease due to complications, which may be fatal



**Figure 1.** Destruction rates in patients with cholesteatoma.

and life-threatening. Therefore, the clinician treating COM must always have a high index of suspicion in order not to miss a critical diagnosis. Imaging studies, especially CT, can provide information regarding the anatomy of the temporal bone and the extent of disease, which may not be apparent on the basis of clinical findings alone.<sup>[3]</sup> Preoperative knowledge of these informations can allow a more accurate evaluation of the case, with better planning of the surgical procedure.

The use of CT scanning in evaluation of COM is controversial. Many otologists prefer CT scan in complicated COM cases, revision surgeries and cases with congenital variations.<sup>[4,5]</sup> However there are also many otologists who suggest that CT cannot be used routinely because a distinction between cholesteatoma, mucosal edema and effusion cannot be made. Furthermore it increases the cost of management and patients are exposed to radiation.

Tomography sections should be taken both in axial and coronal planes in middle ear and temporal bone examinations, since the anatomical structures are better distinguished in different planes.<sup>[6,7]</sup> The scutum, tegmen tympani, head of the malleus, long process of the incus and horizontal part of the facial canal are better evaluated in coronal sections while the sinus tympani, facial recess, lateral semicircular canal, vertical segment of the facial canal and stapes are better evaluated in axial sections.<sup>[8]</sup>

Computed tomography can show soft tissues of the middle ear and the mastoid with approximately

100% sensitivity.<sup>[9]</sup> However it is not possible to determine whether the viewed soft tissue density is cholesteatoma or granulation tissue.<sup>[5,10]</sup> As we did in our study, it is possible to interpret pathology as cholesteatoma when soft tissue density seen with enlarged mastoid cavity and erosion in surrounding bony structures are detected.<sup>[8,11]</sup> Using this criterion, the sensitivity is 60% and the specificity is 77.7% in our study, which is compatible with the literature.

Cholesteatoma may cause destruction of neighboring mastoid structures. Most common destructive findings include erosion in the scutum, dilatation of the aditus and erosion of the lateral epitypanic wall, posterosuperior canal wall, and ossicles.<sup>[12]</sup> Low dural plaque level makes it harder to reach the epitympanum during surgery therefore it is important to know about this before the surgery in order to prevent possible damage to the dural plaque. Our results showed CT scan to be highly sensitive for dural height, temporal bone destruction, and mastoid pneumatization with nearly 100% sensitivity.

Complications of cholesteatoma occur when the lesion erodes the anatomical boundaries of the middle ear, antrum, and mastoid, or involves the facial nerve. The most common complications are lateral canal fistulas, facial canal erosion, and tegmen tympani erosion. Any information provided by CT scan may prevent possible damages to these structures and reduce the risk of complications. In our study, LSCC dehiscence was suggested in three scans, but could only be confirmed in one operation and one of the dehiscences could not be predicted preoperatively. O'Reilly et al.<sup>[7]</sup> detected six of the eight lateral SCC destruction cases via CT and reported a false negative rate of 3.5%. Kvestad et al.<sup>[13]</sup> reported a detection rate of 11 out of 20 cases (%55). Our detection rate for facial canal erosion (3 out of 5 cases with four false positive results) was not so good but comparable to those of O'Reilly et al.<sup>[7]</sup> (4 in 9 cases), and Alzoubi et al.<sup>[14]</sup> (14 in 20 cases). Tegmen tympani erosion was predicted in five scans but noted in four operations and two of the dural exposure cases could not recognized preoperatively. Banarjee et al.<sup>[10]</sup> reported their detection rate as three out of six cases. O'Reilly et al.<sup>[7]</sup> reported their detection rate as five out of eleven cases.

The literature has various rates for preoperative evaluation of ossicular chain destruction via CT. Many otologists emphasize the difficulty of evaluating stapes destruction especially.<sup>[14]</sup> Mafee et al.,<sup>[15]</sup> Banarjee et al.,<sup>[10]</sup> O' Reilly et al.,<sup>[7]</sup> determined destruction of the ossicular chain correctly through preoperative CT at rates of 89%, 82% and 50% respectively. Most authors mention their detection rates of malleus, incus and stapes only. Unlike the others, O'Reilly gives importance the detection of the integrity of the whole ossicular chain. In our study, destruction of the malleus was determined correctly at a rate of 86%, the incus at 84% and the stapes at 54%. However when we consider the condition of whole ossicular chain, our detection rate was 45%.

The radiological findings not only support the clinical diagnosis but also determine the surgical approach. The presence of disease in areas that are difficult to evaluate such as the sinus tympani and the anterior portion of the facial canal, can now be documented. Computed tomography is the first choice in the preoperative work-up (extension of the disease, anatomic variants). Especially in complicated chronic otitis media, scanning with thinner slices would improve the estimation rates of CT. However the tomography used in this study could not produce images smaller than 1 mm section intervals. Moreover for the detection of postoperative residual or recurrent cholesteatoma and intracranial complications, MRI may provide additional information on the delineation of cholesteatoma and on potential complications.<sup>[16,17]</sup>

In conclusion, in line with the literature, our results indicate that CT has a high level of sensitivity in demonstrating soft tissue presence, mastoid pneumatization and bone erosion. On the other hand, sensitivity and specificity of CT are not high enough for demonstrating LSCC and facial canal dehiscence, destruction in the ossicular chain, and distinction between the present soft tissue disease and mucosal edema or effusion.

Preoperative imaging methods enable otologists to decide on the type of the operation. Spotting soft tissue in the middle ear and mastoid cavity helps decide on mastoidectomy and spotting destruction in the ossicular chain indicates the need for reconstruction. Like many otologists, we are of the opinion that CT is not indispensable though it provides invaluable anatomical information. However the opinion that this highly informative

and non-invasive method should not be utilized on children who need to be sedated or in urgent cases when there is no time for a CT, is accepted too.<sup>[6,10]</sup> Computed tomography scans in axial and coronal planes before tympanoplasty has an important place that helps prevent possible intraoperative complications and provides preoperative medicolegal documentation.

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