ORIGINAL ARTICLE

The Examination of Middle Ear Ossicles with Preoperative 64-Detector Computed Tomography in Cases with Chronic Otitis Media and Cholesteatoma and Comparison of Operation Findings

Sermin Tok, Baki Adapinar, Armagan Incesulu, Melek Kezban Gurbuz

Dumlupinar University- Kutahya Evliya Celebi Training and Research Hospital, Department of Radiology (ST)
Eskisehir Osmangazi University; Department of Radiology (BA)
Eskisehir Osmangazi University; Department of Otorhinolaryngology (AI, MKG)

Introduction: Chronic Otitis Media (COM) is among the common infectious diseases seen in developing countries. This disease can either affect the tympanic membrane focally or can cause several complications by penetrating through to the temporal bone. Cholesteatoma is an inflammatory disease of the temporal bone.

Objective: The objective of this study is to evaluate the middle ear ossicle preoperatively with 64 detector tomography in patients with COM and cholesteatoma and to determine the correlations with the operative results.

Materials and Results: This prospective study included 100 cases. Surgery is considered the golden standard for treatment. With multi-slice computed tomography (CT), upon evaluation of the middle ear ossicles of the 100 cases; the sensitivity and specificity for the malleus was found to be 95,1% and and 92,3% respectively, sensitivity and specificity for the incus was 84,6% and 98,4% respectively and the specificity and sensitivity for the stapes was found to be 71,2% and 100% respectively. With multi-slice CT, the highest sensitivity was found for the malleus anterior process (97,1%) and the lowest sensitivity was found for the stapes anterior crus (71,2%).

Conclusion: Consequently, 64 detector computerized tomography can be used with high accuracy in the preoperative evaluation of the middle ear ossicles.

Submitted : 19 April 2013 *Revised : 22 July 2013* *Accepted : 30 July 2013*

Introduction

COM is among the common infectious diseases seen in developing countries. This disease can either affect the tympanic membrane focally or can cause several complications by penetrating through to the temporal bone [1].

Cholesteatoma is an inflammatory disease of the temporal bone [2] and generally develops in the middle ear. It is a result of the development of keratinized squamous epithelium in the middle ear [3].

The tympanoplasty procedure, which aims to protect the hearing function and repair the COM and cholesteatoma of the middle ear is divided into five fundamental groups according to the bypass level of the ossicular chain. Determining the status of the ossicular chain in the preoperative period is critical in planning the operation [4]. In several studies, middle ear ossicles have been evaluated with axial, coronal plan CT images and virtual endoscopy and high accuracy rates have been reported [5-7].

Corresponding address:
Sermin Tok
sermintok@hotmail.com
Tel No: +905366384272
Fax: +902742316673

The objective of this study is to evaluate the middle ear ossicle preoperatively with 64 detector tomography in patients with COM and cholesteatoma and to determine the correlations with surgery results .

Materials and Methods

Following physical examination, otoscopic examination and audiometry studies; temporal CT was performed on 184 patients presenting with COM and cholesteatoma. Of these patients, 106 of them underwent surgery. Six patients with a previous history of surgery were excluded from the study. The remaining 100 surgical cases were included in the study. The age range of the operated patients was between 4-66 years. There were 44 male and 56 female patients.

Temporal CT imaging was performed with the multi- slice CT (MSCT) equipment (Aquillion 64, Toshiba Tokyo, Japan) in supine position. With the DICOM imaging program (Vitrea; Vital Images), multiplanar reconstruction sections (MPR) were created. The middle ear ossicles were evaluated by reconstruction according to their axes. In the multi-slice CT images and operations; resorptive changes in the middle ear ossicles, total resorption or the lack of any affect were evaluated.

Results

Multi-sectional CT images of the 100 ears of the 100 study cases were evaluatedfor the resulting effects of COM or cholesteatoma. However, operational findings were considered the golden standard.

With multi-slice CT evaluation of the middle ear ossicle of the 100 cases; for the malleus, sensitivity was found to be 95,1% and specificity was found to be 92,3%, for the incus, sensitivity was 84,6% and specificity was 98,4% and for the stapes specificity was 71,2% and sensitivity was 100%. (Table 1) (Figures 1-2).

When the multi-slice CT images were considered according to the segments of the middle ear ossicles; the highest sensitivity was found for the malleus anterior process (97,1%) and the lowest sensitivity was found for the stapes anterior crus (71,2%) (Table2).

Table 1. Statistical evaluation of operational results for the middle ear ossicles with temporal bone 64 detector MSCT

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Malleus	95,1%	92,3%	95,1 %	92,3%
Incus	84,6%	98,4%	97,1%	90,9%
Stapes	71,2%	100%	100%	76,2 %

Table 2. Statistical evaluation of the operational results of the middle ear ossicular segments with temporal bone 64 detector MSCT

	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Malleus head	95,70%	100%	100%	90,90%
Manibrium mallei	96,90%	97,10%	98,40%	94,40%
Malleus lateral process	95,80%	93,10%	97,10%	90,00%
Malleus anterior process	97,10%	96,70%	98,60%	93,50%
Incus body	95,40%	94,30%	96,90%	91,70%
Incus long crus	83,30%	96,60%	94,60%	88,90%
Incus short crus	93,40%	97,40%	98,30%	90,50%
Stapes body	89,10%	100%	100%	83,70%
Stapes anterior crus	71,20%	100%	100%	76,20%
Stapes posterior crus	73,10%	100%	100%	77,40%
Lenticular process	89,10%	100%	100%	91,50%

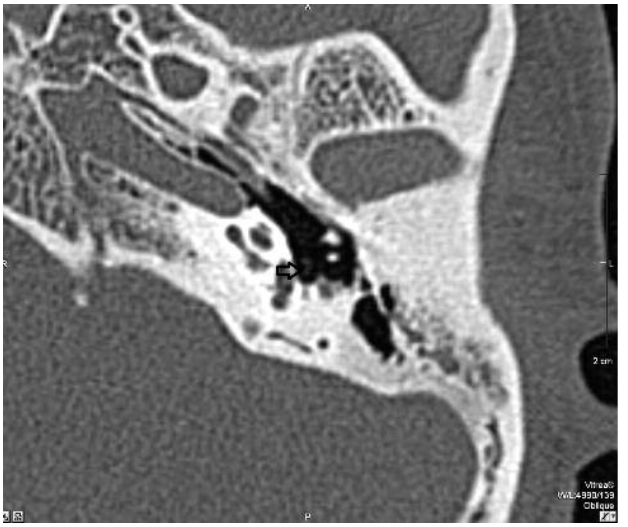

Figure 1. A 29-year-old male case. There were resorptive alterations noted in the left middle ear stapes distal crus on CT (black arrow) and during surgery.

Figure 2. A 49-year-old male case. While the stapes cannot be seen on temporal CT, it was reported to be present during the operation.

With temporal bone MSCT imaging; the stapes was found to be fixed in one patient and the malleus was found to be adherent to the promontorium in one patient. These findings were confirmed with the findings during the operations.

Discussion

In patients having surgery for chronic otitis media, necrotic changes are detected in the middle ear ossicle[1]. Resorptions occurring in the ossicle chain are one of the major complications of COM. Ossicle chain resorptions determine the type of ossiculoplasty to be performed following masteidectomy[5]. Computerized tomography is the standard imaging technique for the temporal bone [8].

Pandey et al performed temporal bone studies with high resolution CT (HRCT) and virtual endoscopy in patients with COM. Ossicle changes observed during the operation were compared with HRCT and virtual endoscopy findings. The sensitivity of HRCT is proportional with the sizes of the ossicles and was found to be highest for the malleus (100%), then the incus (85,29%) and least for the stapes (76,97%). The virtual otoscopy accuracy rate was found to be highest for the malleus (100%), lower for the incus (88,24%) and lowest for the stapes (85,29%) [5]. In a study by Park et al conducted with the findings of axial and coronal temporal bone HRCT; the sensitivity to ossicle destruction was found to be 97,7% for the malleus, 100% for the incus and 97,1% for the stapes [6]. In our study, although the sensitivity ranking was similar to the study by Pandey et al., the rates were lower. In the study by Park et al, while the sensitivity was highest for the incus, in both our study and Pandey et al.'s study the highest sensitivity was detected for the malleus.

In the study by Pandey et al., when the middle ear ossicles were evaluated by sections, while the highest accuracy of HRCT and virtual endoscopy was for the manibrium mallei (100%), in our study the highest accuracy was for the malleus anterior process (97,1%). Pandey et al did not evaluate the sections of the stapes. In our study, the lowest accuracy was detected for the stapes anterior crus (71,2%) [5].

Egeli et al. evaluated the CT coronal plane in 22 cases and both CT coronal and axial planes in 20 cases. When the surgical and CT image findings of the ossiclar chain were compared, the sensitivity of CT for detecting ossiclar chain continuity was found to be 41.4% and, and diagnosis accuracy was detected as being 63.2% [7]. In our MPR evaluation, when the ossicle was considered on an individual basis, the sensitivity and accurate diagnosis rate was

significantly higher than the coronal and axial plan CT imaging studies.

Aydil et al. performed temporal bone studies with 16-MSCT. Ossicle changes observed during surgery were compared with reformatted 2D and reconstructed 3D images findings. The sensitivity of reformatted 2D images was found to be highest for the incus long process (72,7%) and least for the stapes suprastructure (50,0 %). The sensitivity of 3D reconstructed images was found to be highest for the stapes suprastructure (100 %) and lowest for the incus body (42,9 %)[9]. In our study, the highest sensitivity was for the malleus (95,1%) and the least sensitivity was for the stapes (71,2%). According to these studies, 3D images are better than 2D images in the evaluation of smaller parts.

In conclusion, 64 detector computerized tomography can be used for its high accuracy in the preoperative evaluation of the middle ear ossicle for COM and cholesteatoma operations.

References

1. Faramarzi A, Motasaddi-Zarandy M, Khorsandi MT. Intraoperative findings in revision chronic otitis media surgery. ArchIranianMed 2008;11:196-199.

2. Sengupta A, Anwar T, Ghosh D, Basak B. A study of surgical management of chronic suppurative otitis media with cholesteatoma and its outcome. Indian J Otolaryngol Head Neck Surg2010; 62:171-176.

3. Tos M, editor. Manuel of MiddleEarSurgery. New York; ThiemePress; 1995.

4. Koc C, editor. Cummings Otolaryngology Head and Neck Surgery. Istanbul; Gunes Medical Bookstore; 2007.

5. Pandey AK, Bapuraj JR, Gupta AK, Khandelwal N. Is there a role for virtual otoscopy in the preopertive assessment of the ossicular chain in chronic suppurative otitis media? Comparison of HRCT and virtual otoscopy with surgical findings. EurRadiol 2009; 19:1408-16.

6. Park KH, Park SI, Kwon J, Kim YM, Park IY, Sung KJ. High-resolution computed tomography of cholesteatoma and otitis media: significance of preoperative information. YonseiMed J. 1988;29:367-72.

7. Egeli E, Arslan H, Akkaya S. The comparison of computerized tomography and surgical findings for otitis media. Turkish Otolaryngology Archive 1999;37:117-120.

8. Mafee MF. MRI and CT in the evaluation of acquired and congenital cholesteatomas of the temporal bone. J Otolaryngol.1993;22:239-48

9. Aydil U, Koksal A, Ozcelik T, Ozgirgin N. Comparison of reformed two-dimensional images with three-dimensional reconstructions based on images from multi-detector computed tomography of the temporal bone in surgical candidates of chronic otitis media patients. İnt. Adv. Otol. 2010;6: 337-341.