FACIAL CANAL DEHISCENCE AND COEXISTING ABNORMALITIES; RADIOLOGICAL- SURGICAL CORRELATION

FASİAL KANAL DEFEKTİ VE EŞLİK EDEN ANOMALİLER; RADYOLOJİK CERRAHİ KORELASYON

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Öz

Amaç: Fasial kanal defekti (FKD) kolesteatom cerrahisinde en dikkat edilmesi gereken durumlardan biridir. Vakaların büyük çoğunluğunda timpanik porsiyon defektin en çok görüldüğü lokalizasyondur. ÇKBT temporal kemik görüntülemesinde standart metottur. Bu çalışmada cerrahide FKD saptanan olgularda eşlik eden radyolojik-cerrahi bulguları karşılaştırmayı amaçladık. Gereç ve Yöntem: Retrospektif olarak Fakültemizde Nisan 2011 ve Nisan 2016 tarihleri arasında opere olan 351 hastadan peroperatif MDBT tetkiki olan 64 hastanın radyolojik ve cerrahi bulgularını karşılaştırdık. Bulgular: Pozitif cerrahi bulgular dış kulak yolu (DKY) hasarı (31.2%), FKD (100%), antrum genişlemesi (AG) (57.8%), kemikçik erozyonu (96.8%), lateral semisirküler kanal (LSSK) defekti (18.7%), süperior semisirküler kanal (SSSK) defekti (1.5%) ve kohlear defekt (4.6%) idi. Pozitif ÇKBT bulguları dış kulak yolu (DKY) hasarı (37.5%), FKD (93.7%), antrum genişlemesi (AG) (82.8%), kemikçik erozyonu (96.8%), lateral semisirküler kanal (LSSK) defekti (18.7%), süperior semisirküler kanal (SSSK) defekti (6.2%) ve kohlear defekt (4.6%) idi. Bu çalışmada ÇKBT'nin en hassas belirlediği patolojiler FCD (93.7%), AG (82.8%),kemikçik erozyonu (96.8%) and scutum hasarı (68.7%) idi. Kemikçik erozyonu, AG ve LSSK fistula cerrahi ve BT bulguları korelasyon analizinde pozitif ilişki gösterdiler (p=0.001). Tartışma: ÇKBT ve klinik bulgular arasındaki korelasyonlar cerrahi öncesi muhtemel sorunların daha iyi teşhisine yol açabilir ve kolesteatoma cerrahilerinin başarısını artırır. Çok düzlemsel görüntülemenin kombine analizi, özellikle timpanik bölgede FKD'nin pozitif teşhis oranını geliştirmektedir.

Anahtar Kelimeler
Çok Kesitli BT; Fasial Kanal; Defekt

Abstract

Aim: Facial canal dehiscence (FCD) is the most important consideration in the cholesteatoma surgery. The tympanic portion is the most common localization of FCDlization in the majority of cases. MDCT is the standardt imaging modality for temporal bone screening. In this study we aimed to compare coexisting the radiological and -surgical findings of patients who have were found during surgery to have FCD in surgery. Material and Method: We examined retrospectively 351 patients with cholesteatoma who have beenwere operated on between April 2011and April 2016. In terms ofFor this study FCD, we compared the preoperative temporal bone MDCT and the surgery findings of 64 patients with FCD. Results: Positive surgical findings included external auditory canal (EAC) destruction (31.2%), FCD (100%), aditus ad antrum widening (AW) (57.8%), ossicular erosion (96.8%), lateral semicircular canal (LSSC) defect (18.7%), superior semicircular canal (SSSC) defect (1.5%), and cochlear defect (4.6%). Temporal bone MDCT positive findings included EAC destruction (37.5%), FCD (93.7%), AW (82.8%), ossicular erosion (96.8%), LSSC defect (18.7%), superior semicircular canal (SSSC) defect (6.2%), and cochlear defect (4.6%). The maximal precision of MDCT imaging in this study was in defining FCD (93.7%), AW (82.8%), ossicular erosion (96.8%), and scutum destruction (68.7%). Surgical and CT findings of ossicular chain erosions, AW, and LSCC fistula showed positive relations inwere positively correlated correlation analyses (p=0.001). Discussion: The significant correspondence between MDCT and clinical findings indicates that MDCT may lead to better a diagnosis of probable likely problems before cholesteatoma surgery, and and to a higherimproves the success rate of cholesteatoma those surgeries. The combined analysis of multi-planar imaging improves the positive diagnosis rate of FCD, especially ion the tympanic portion.

Keywords
MDCT; Facial Canal; Dehiscence

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Introduction

Cholesteatoma is a keratin- producing stratified squamous epithelium accumulation in the middle ear or in the other pneumatized areas of temporal bone such as the mastoid and petrous apex [1]. Although it is rare in the middle ear, facial nerve paralysis can be seen in %20-64% of extensive cholesteatoma cases [2]. Facial nerve damage during ear surgery is considered among one of the most dangerous potential complications for the otologic surgeon.

Facial canal defect increases the risk of injury and may serve as a warning to surgeons of the underlying hazard. The prevalence of facial canal dehiscence (FCD) has been reported to be 25–57% in histological studies of the temporal bones of normal humans [3]. The surgical rates of dehiscence reach 0.5–11.4 % in conditions other than chronic otitis surgery [4] and 33 % in chronic otitis surgery [4-6]. Although dehiscences are most commonly detected in the tympanic segment and at the level of fenestra ovalis , they may also be seen at the level of geniculate ganglion and in the mastoid segment [7].

The iatrogenic facial nerve damage due to cholesteatoma-related bone erosion or anatomical variations may occur during the dissection of the cholesteatoma from the middle ear cavity, epitympanum, and mastoid cavity. An accurate preoperative evaluation of facial canal anatomy and its relationship with the surrounding pathology is necessary in these cases. Understanding the ear anatomy with detailed radiographic information on the bony canal of the facial nerve and determining the extentsion and site of cholesteatoma can minimize the likelihood of facial nerve damage during the operation. High-resolution multi-detdector computed tomography (MDCT) provides important informations in this regard since it can determine the cholesteatoma sac and, assess the ossicles, the facial nerve, tegmen, scutum, and inner ear structures.

To our knowledge, there are few reports concerning the correlation of MDCT findings with surgical findings on the condition of the FCD of cholesteatoma [8-9]. In this study we aimed to assess the usefulness of a preoperative MDCT imaging in depicting the dehiscence of the facial canal and the status of middle ear structures in the presence of cholesteatoma and to compare the MDCT findings with the clinical intraoperative findings.

Material and Method

We examined retrospectively 351 patients with cholesteatoma who have beenwere operated on in Ondokuz Mayıs University Medical School Hospital, Ear, Nose, and Throat Clinic between April 2011and April 2016. To avoid repetition of the same data fromin ears that had been operated on more than once, only the data for one ear were included in the study. Based on the operation notes, 125 of the patients have been found withexperienced facial canal dehiscence in the operation. In terms of facial canal dehiscence Of these patients, 64 of these patients had preoperative temporal bone MDCT investigation.

Based on the patient files, the age, gender, preoperative CT, and intraoperative findings were determined. The data were examined in terms of the presence or absence of destruction of the external auditory canal, scutum, and tegmen;, the localization of cholesteatoma;, the presence or absence of facial canal dehiscence;, the localization of the dehiscence;, the presence of semicircular-circular canal fistulas; and, the conditions of the ossicle chain, Pprussak's sSspace, and mastoid air spaces.

MDCT imaging was performed with a 16-slice multi-detector row CT scanner (Aquilion 16 system, Toshiba Medical Systems Corporation, Tokyo, Japan) and 128-slice multi-detector row CT scanner (Discovery, GE Healthcare, Milwaukee, WI). The scanning parameters used were a collimation of 1 mm, mAS: 250, kV: 120, matrix: 512×512, algorithm: bony, and reconstruction thickness: 0.5 mm. DICOM files were retrieved from the archive system and transferred to the Osirix Workstation for review.

Statistical analyses wereas done with SPSS, version 21.version (IBM Corporation, Armonk, NY, USA). The Shaphiro-Wilk test was used to determine the normality in of the distribution of the quantitative data. To compare two independent groups, Student's t-test wasere used. Correlation analyses were performed with the Spearman's rho test. A p value less than 0.05 was considered statistically significant.

Results

Sixty-four patients, including 43 males (67%) and 21 females (33%), were enrolled into the study. The mean age of the patients was 36.5 (range, 8-75) years. Of the 64 subjects, 9 (14%) were aged below 18 years and 55 (86%) were aged above 18 years at the time of the operation. The facial canal dehiscence was observed on the right side in 31(48%) and on the left side in 33 (52%) patients.

Positive surgical findings included external auditory canal (EAC) destruction (31.2%), FCD (100%), aditus ad antrum widening (AW) (57.8%), ossicular erosion (96.8%), lateral semicircular canal (LSSC) defect (18.7%), superior semicircular canal (SSSC) defect (1.5%), and cochlear defect (4.6%). Temporal bone MDCT positive findings included EAC destruction (37.5%), FCD (93.7%), AW (82.8%), ossicular erosion (96.8%), LSSC defect (18.7%), superior semicircular canal (SSSC) defect (6.2%), and cochlear defect (4.6%). The maximal precision of MDCT imaging in this study was in defining FCD (93.7%), AW (82.8%), ossicular erosion (96.8%), and scutum destruction (68.7%). The accuracy, sensitivity, specificity, and predictive values for different MDCT findings are shown demonstrated in Table 1.

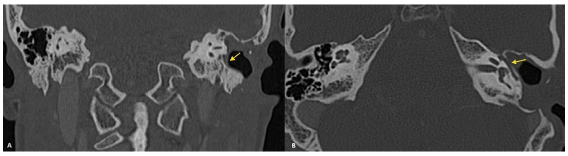

Fig.1. A. Facial canal dehiscence in the mastoid segment (arrow) of left side on the coronal temporal bone MDCT image. B. Facial canal dehiscence in the tympanic segment (arrow) of the left side and soft tissue in the left tympanic cavity on the axial temporal bone MDCT image.

The facial canal dehiscence was observed on the right side in 31(48%) and on the left side in 33 (52%) patients. The localization of the dehiscence was classified as being in the tympanic segment, in the mastoid segment, in the tympanic + mastoid segments, or in the first or second genu. According to surgery reports, the dehiscence was detected in the tympanic segment in 52 (80%) subjects, in the mastoid segment in 3 (4.6%) subjects, in the tympanic + mastoid segments in 4 (6.1%) subjects, in the first genu in one (1.5%) subject, and in the second genu in 4 (6.1%) subjects. The CT findings of facial canal dehiscence-FCD was detected in the tympanic segment in 56 (93.,3%) subjects, in the tympanic + mastoid segments in 4 (6.6%) subjects, and in the first genu in one (1.5%) subject. According to surgery reports, Oof the 64 subjects with FCD, 3 (4.6%) had isolated malleus defects, 10 (15.6%) had isolated incus defects, 4 (6.2%) had isolated stapes defects, 12 (18.7%) had incus + malleus defects, 12 (18.7%) had incus + stapes suprastructure defects, and 23 (35.9%) had defects in all ossicles according to surgery reports. The CT findings revealed isolated malleus defect in one (1.5%) subject, isolated incus defect in 7 (10.9%) subjects, isolated stapes defect in 6 (9.3%) subjects, incus + stapes suprastructure defect in 6 (9.3%), subject and all ossicle defects in 43 (67.1%) subjects. When isolated involvement is considered, the presence of incus defect was higher thaen the others in both CT and surgery findings.

Surgical and CT findings of ossicular chain erosions, AW, and LSCC fistula showed positive relations in correlation analyses (p=0.001). The presence of LSCC fistula related correlated with scutum defect on CT findings (p=0.002) (Table 2). While LSCC fistula and AW were correlated positively according toin the surgical findings, they did were not correlated in theon CT findings. The CT findings of scutum defect and AW also did were not correlatedd significantly.

The CT findings revealed soft tissue in the Prussak's space, also known as pouch of the outer attic, in %92% of patients, while the surgical findings noted it only inin only %12% of patients.

The CT findings revealed low-lying tegmen in 2 (3.1%) subjects, thinned tegmen in 18 (28.1%) subjects, tegmen tympani defect in 16 (25%) subjects, high jugular bulb (HJB) in 12 (18.7%), subjects and HJB defect in 2 (3.1%) subjects.

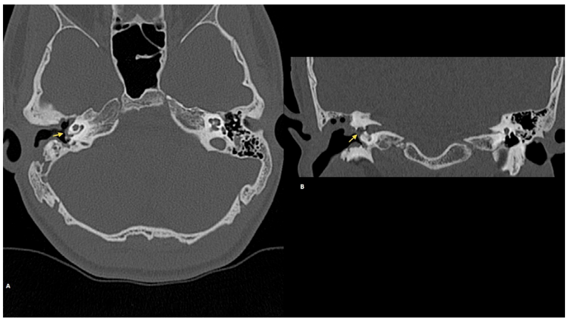

Fig.2. Lateral semicircular canal defect due to cholesteatoma on the axial (A) and coronal (B) temporal bone MDCT images (arrows).

Discussion

Today MDCT is considered the standard imaging method for the temporal bone. However,, but its value in the preoperative examination of chronic otitis media and cholesteatoma patients remains unclear. MDCT imaging with screening in three planes, has the ability tocan display pathologies of the temporal bone in detail. The present study revealed demonstrated good relcorrelationation between MDCT findings of temporal bone andwith surgical findings in patients with facial canal dehiscenceFCD. The facial canal dehiscenceFCD may be de-

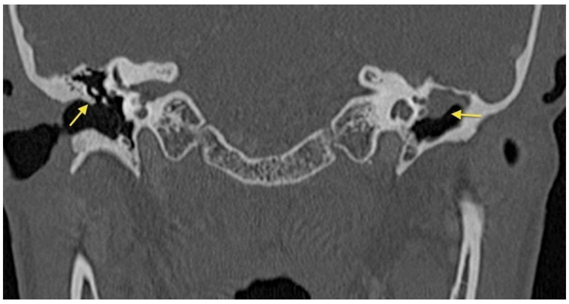

Fig.3. Scutum erosion due to soft tissue in the left epi-mesotypanium seen on the coronal temporal bone MDCT image (transverse arrow). Note that intact scutum (oblique arrow) on the right side.

velopmental due to inadequate ossification of the bony canal or it may also arise from resorption caused by chronic otitis media, with or without cholesteatoma. Although there is In the presence of a wide range of opinion in the literature concerning about the incidence of dehiscence [10,11], most sources of them concur that the tympanic portion is the most frequent site in the localizations of dehiscence [12-14]. In concordance with these reports, our study also demonstrated the furthest most frequent occurrence of FCD in the tympanic segment. As mentioned documented in previous CT studies [8,10], the dehiscence of the bony wall of the tympanic portion and their its position and extent can be noted on both axial-transverse and coronal CT images. The MDCT and surgical findings hadve good radio-surgical relationship in most the predominance of our cases. Based on our study, Wwe believe that combining use of analysis of multi-planar viewsanalysis, which visualizes the subject from multiple angles to the wall, with advantage of showing from different angels to the wall improvesd the positive rate of diagnosis of dehiscence in the tympanic portion of the facial nerve canal in our study. However, in four4 cases we could not reach a diagnosis about the condition of the tympanic portion from CT imaging in 4 cases due to partial volume averaging with adjacent soft tissue. Thus there is no guarantee of diagnosis and surgeons should keep oncontinue to take additional care during surgical treatment. At this point, there areis no radiological means to observe the dehiscence of the facial nerve canal with complete accuracy.

This study has demonstrated a good correlation between temporal bone MDCT scans with and surgical findings, particularly in ossicular chain erosions, AW, and LSCC fistula. Rogha et al. have also reported good radio-surgical correlation of AW in cholesteatoma patients (9). The current study also demonstrated the advantage of MDCT imaging in the detection of tympanic and mastoid cholesteatoma, ossicular chain erosion, scutum and EAC destruction, SSSC, and cochlear defect.

Bone erosion is an important pathological finding in otitis media; it can, which leads to hearing loss due to an impaired impairment of the sound transmission mechanism. Although the presence of cholesteatoma is not necessary forthe only possible cause of the destruction of the ossicleossicle destruction, bone destruction is known to be more common in patients with cholesteatoma [15]. In the current CT study, we also found defects in the ossicle chain, at an incidence of 67.1%, similar with to previous studies [16]. Ossicular chain erosion demonstrated occurred as an isolated defect most commonly at the incus in both surgical (15.6%) and CT (10.9%) findings. The Llow rate of incus defects on the CT images may be due to a partial volume effect. In this regard, an the defect of incus defect may alert the surgeon about to the dehiscence of the facial nerve canal. Low detection rates of isolated malleus and malleus + incus involvement and high detection rates of all ossicles involvement on CT findings may be due to the small size of these bones.

Ozbek et al. [17] detected LSCC fistula in 21.1% of subjects with facial nerve dehiscence and Gulustan et al. [16] detected it in 27.8% LSCC fistula of subjects with facial nerve dehiscence. In our study, Bboth the MDCT and surgical findings of our study revealedindicated a similar LSCC fistula range occurrence rate of 18.7% LSCC fistula in patients with facial nerve dehiscence. Presence of LSCC fistula in this study may alert the surgeon to that detection of one may indicate the existence of the otherFCD, potentially leading to a decrease in iatrogenic complications.

Although there is noare no reports in the literature of a correlation, in our study, 37.5% of subjects with facial nerve dehiscence also had destruction in the posterior wall of the EAC. We think that it is athis high range of incidence that should be considered in terms ofmay indicate a correlation between the two. association of dehiscence.

In our study, the Ccoexistence of scutum defects and facial canal dehiscence was as high as in the previous study of Genc et al. [18]. This suggests that the presence of a scutum defect is a significant finding in thein predictingion of the extent of the disease and facial canal dehiscence. Beside a good anatomical knowledgeThis it indicates that the surgeons should, in addition to having good anatomical knowledge, pay more attention to avoiding facial nerve injury during the operation ofwhen operating on patients with a scutum defect.

Our study demonstrated HJB and defect in HJB and tegmen tympani. Tegmen tympaniTegmen tympani is the thin layer of bone that forms the roof of the tympanic cavity, separating it from the cranial cavity. It has an important protection function in protecting theof brain from extending cholesteatoma. Its dehiscence and whether it is a low-lying type should be considered before surgery to avoid iatrogenic additional injuries. Thus,So apart from facial nerve dehiscence, CT imaging has an important role in detecting not only facial nerve dehiscence but also of detecting cholesteatoma propagation that can not be precisely evaluated exactly duringin surgery.

Conclusion

In this study, we compared the surgical and preoperative MDCT findings of patients who have were detected to have facial canal dehiscence during cholesteatoma surgery. Our study reveals that preoperative MDCT imaging can show the tympanic portion of the facial nerve canal accurately in the vast majority of cases, and there is high correlation of MDCT data with surgical findings in these cases. The combined analysis of multi-planar imaging improves the positive diagnosis rate of FCD, especially in on the tympanic portion.

In our study, Tthe incus was the most commonly destroyed ossicle. LSCC fistulas, scutum defects, and EAC defects were coincidental findings of FCD. The significant correspondence between MDCT and clinical findings may lead to better a diagnosis of probable likely problems before surgery, and it improves the success rate of cholesteatoma surgeries.

Competing interests

The authors declare that they have no competing interests

References

1. Crandall MA, Neiberg MN, Seger KR. Neuroophthalmic manifestations of a complicated cholesteatoma. Optometry 2010; 81(3): 137–41.
2. Baráth K, Huber AM, Stämpfli P, VargaZ, Kollias S. Neuroradiology of cholesteatomas. AJNR 2011;32(2):221-9.
3. Moreano EH, Pararella MM, Zelterman D, et al. Prevalence of facial canal dehiscence and of persistent stapedial artery in the human ears: a report of 1000 temporal bones. Laryngoscope 1994;104:309–20.
4. Magliulo G, Colicchio MG, Ciniglio M. Facial nevre dehiscence and cholesteatoma. Ann Otol Rhinol Laryngol 2011; 120:261–7.
5. Selesnick SH, Lynn-Macrae AG. The incidence of facial nerve dehiscence at surgery for cholesteatoma. Otol Neurotol 2001; 22:129–32.
6. Moody MW, Lambert PR. Incidence of dehiscence of the facial nerve in 416 cases of cholesteatoma. Otol Neurotol 2007;28:400–4.
7. Lin JC, Ho KY, Kuo WR, Wang LF, Chai CY, Tsai SM. Incidence of dehiscence of the facial nerve at surgery for middle ear cholesteatoma. Otolaryngol Head Neck Surg 2004; 131:452–6.
8. Yu Z, Wang Z, Yang B, Han D, & Zhang L. The value of preoperative CT scan of tympanic facial nerve canal in tympanomastoid surgery. Actaoto-laryngologica 2011; 131(7):774-8.
9. Rogha M, Hashemi SM, Mokhtarinejad F, Eshaghian A, &Dadgostar A. Comparison of preoperative temporal bone CT with intraoperative findings in patients with cholesteatoma. Iranian journal of otorhinolaryngology 2014;26(1):7-12.
10. Dimopoulos PA, Muren C, Smedby O, Wadin K. Anatomical variations of the tympanic and mastoid portions of the facial nerve canal. Acta Radiol 1996;37(Suppl 403):49–59.
11. Takahashi H, Sando I. Facial nerve dehiscence: histologic study and computer reconstruction. Ann Otol Rhinol Laryngol 1992;101:925–30.
12. Proctor B, Nager GT. The facial canal: normal anatomy, variations and anomalies. Ann Otol Rhinol Laryngol Suppl 1982;97:33–61.
13. Weiglein AH, Anderhuber W, Jakse R, Einspieler R. Imaging of the facial canal by means of multiplanar angulated 2-D high- resolution CT-reconstruction. Surg Radiol Anat 1994;16:423–7.
14. Moreano EH, Paparella MM, Zelterman D, Goycoolea MV. Prevalence of facial canal dehiscence and of persistent stapedial artery in the human middle ear: a report of 1000 temporal bones. Laryngoscope 1994;104:309–20.
15. Wright CG, Mayerhoff WL. Pathology of otitis media. Ann Otol Laryngol 1994;103:24–6.
16. Gülüstan F, Aslan H, Songu M, Başoğlu MS, & Katılmış, H. Relationships between facial canal dehiscence and other intraoperative findings in chronic otitis media with cholesteatoma. American journal of otolaryngology 2014: 35(6):791-95.
17. Ozbek C, Tuna E, Ciftci O, et al. Incidence of fallopian canal dehiscence at surgery for chronicotitismedia. Eur Arch Otorhinolaryngol 2009;266:357–62.
18. Genc S, Genc MG, Arslan IB, &Selcuk A. (2014). Coexistence of scutum defect and facial canal dehiscence. European Archives of Oto-Rhino-Laryngology 2014;271(4): 701-5.

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