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Otosclerosis and complications of stapedectomy: CT and MRI correlation

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1. Introduction

Otodystrophy of the otic capsule or what is known as otosclerosis (OS) is seen located in the majority of patients in the anterior aspect of the oval window or what is known as the fissula ante fenestrum.[1] Patients usually present between the ages of 10 and 40 with hearing loss whether conductive, sensorineural or mixed hearing loss; depending on the type of otosclerosis.[2] There are two types of otosclerosis; fenestral and retrofenestral. The classical clinical findings are an intact tympanic membrane with no signs of middle ear inflammation, progressive conductive hearing loss (CHL) and absent stapedial reflexes.[3–7]

Usually, clinicians do not proceed to imaging those patients with the typical clinical picture. A Stapedectomy with stapes prosthesis is the treatment of choice for fenestral otosclerosis.[3–7]

Since its introduction into otology, the computed tomographic (CT) scan has been shown to be a useful instrument for diagnosis of otosclerosis.[3] Many studies found a reliability of more than 90% in the diagnosis of otosclerosis.[3]

The temporal bone is fully imaged with no need for intravenous contrast material. Axial images best demonstrate the lucent spongiotic fenestral otosclerotic foci because of the location of the footplate of stapes as well as that of the oval window.[2]

Stapedectomy usually involves stapes prosthesis insertion in an aim to improve hearing by removing the fixed stapes bone and replacing it with a microprosthesis. Prosthesis insertion may be linked to a few built-in problems such as outward displacement or inward protrusion of the prosthesis into the vestibule, granuloma development to the more serious complications as labyrinthitis or perilymphatic fistulas. HRCT is the modality of choice as it accurately shows the position of the prosthesis and helps to exclude other complications mentioned above. Because of the hyperdensity of the prosthesis, it can be easily identified on HRCT. However, MRI may be needed as a supplementary study to exclude labyrinthitis or fibrotic changes within the labyrinth.[4,5,8–10]

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Aim of this study is to assess the importance and utility of both CT and MRI in the evaluation of poststapedectomy complications and to properly select the right imaging modality according to the suspected clinical postoperative complication.

2. Materials and methods

2.1. Patients

From September 2015 to July 2016, we evaluated twenty patients; including 12 females and 8 males, aged 31–64 years old, with a mean age of 47.5. They were all referred from the ENT surgical department. All are known cases of otosclerosis with history of stapedectomy, ranging from 4 weeks to 2 years ago. Their clinical presentation included hearing loss (8 cases), vertigo (7 cases) and routine follow up (5 cases). Onset of symptoms ranged from 4 weeks following the operation to up to 2 years later.

CT was done for all the 20 patients followed by an MRI study for only two patients where CT showed no well-defined cause and labyrinthitis was suspected. CT/MR diagnosis was correlated with the clinical diagnosis and the operative findings as the standard of reference. The study was supported by the ethical board of our institution.

2.2. Imaging technique

MDCT examinations were performed with Siemens Somatom Definition Flash, 128 slice combined with Advantage Workstation GE; parameters consisted of a voltage of 120 kV, a current of 240 mA, FOV 16cm, pitch/speed 1, and a rotation time 1, no gantry tilt: 0, slice thickness 0.4 mm at 0.4 mm interval, patient position: supine. No intravenous contrast was given to the patients in the routine study. Acquisition of ultra-thin axial cuts was done using a multidetector CT machine, with reformats taken in both coronal and sagittal planes with respect to the lateral semicircular canal. MRI was done for only 2 patients around 5–7 days after CT imaging. Stapedectomy is not a contraindication for doing an MRI. MRI was performed on a 3 T unit. The conventional T1 and T2 weighted sequences were done with a slice thickness of 2 mm. Both axial as well as coronal planes were taken, for better spatial assignment. T1- weighted sequence following IV contrast administration was also acquired. A 3D high resolution heavily T2 weighted submillimetre was then followed to allow evaluation of the facial vestibulo-cochlear nerve complex and for detection of alterations in the labyrinth.

2.3. Images interpretation

All images were reviewed and analyzed by two radiologists. CT interpretation included a comment on the position of the stapes prosthesis for either migration or protrusion, exclusion of perilymphatic fistula and labyrinthitis ossificans as well as middle ear assessment for any soft tissue lesions. MRI interpretation included evaluation of T1 and T2 signal intensity as well as postcontrast enhancement of the membranous labyrinth.

3. Results

A total of 20 symptomatic patients poststapedectomy were submitted for Multidetector CT examination with 2 of the cases followed by an MRI study. Seven (35%) patients showed medial migration of the prosthesis into the vestibule (Fig. 1). Six (30%) patients were diagnosed as outward protrusion of the prosthesis (Fig. 2). Two patients (10%) showed a perilymphatic fistula (Fig. 3). Three patients (15%) had a lesion in the oval window region (Fig. 4). Two patients (10%) showed signs of labyrinthitis diagnosed on MRI (Fig. 5). The radiological results were in concordance with the intraoperative findings.

4. Discussion

Otosclerosis is a disease resulting in various foci of bone resorption involving the otic capsule region and is characterized by the presence of demineralization in the active phase followed by sclerosis in remission.[11–13] The recommended surgical procedures for otosclerosis are Stapedotomy or stapedotomy.[17]

Stapedectomy involves the insertion of a stapes prosthesis aiming to restore ossicular chain linkage. A variety of different stapes prosthesis are available, with different materials used as Teflon, stainless steel and platinum; all of which are of variable hyperdensities on CT.[15] 80% of the causes for surgical revision are due to surgical failure, which is why imaging following the operation is extremely essential in the therapeutic decision. Least encountered complications are the labyrinthine complications reaching to less than 20%. Main complications following surgery are: prosthesis displacement, fibrosis of the oval window, incudo-mallear dislocation, and obliterative otosclerosis.[1]

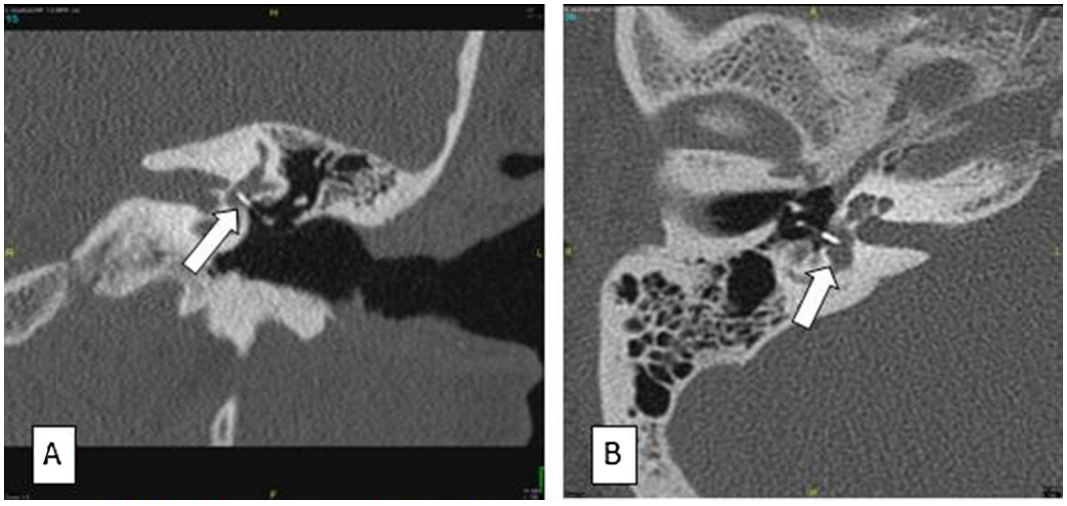

Fig. 1. Two different patients with vertigo and dizziness postoperative to stapes surgery. (A) Coronal CT reformatted and (B) axial CT images showed intravestibular protrusion of the prosthesis superior to 2 mm (arrows).