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Variations in the labyrinthine segment of facial nerve canal revealed by high-resolution computed tomography

Aiyan Jin [a], Peng Xu [a,*], Fengqin Qu [b]

[a] Department of Otolaryngology, Cangzhou Central Hospital, Cangzhou 061001, Hebei Province, China
[b] Department of Otolaryngology, First People's Hospital of Shangqiu, Shangqiu City, Henan Province, China

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ABSTRACT

Objective: To study variations in the labyrinthine segment of fallopian canal and the associated middle and inner ear malformations.
Method: The high-resolution computed tomography (HRCT) images of the temporal bone in 24 patients with congenital variations in the labyrinthine segment of fallopian canal were analyzed retrospectively. The length of labyrinthine segment of the facial nerve and angle of the first genu of 10 normal subjects were also measured. Based on the original axial images, multi-planar reformation (MPR) and curved-planar reformation (CPR) images of bilateral ossicular chains, inner ear structure and fallopian canal were reconstructed. HRCT features of congenital variations in the labyrinthine segment of the facial nerve were analyzed, including its beginning site, dehiscence, length, angle of the first genu and the associated middle and inner ear malformations.
Results: Among the normal subjects, the length of labyrinthine segment of the facial nerve was 3.56 ± 0.41 mm, and angle of the first genu was $71.87 \pm 8.09°$. Five types of variations in the labyrinthine segment of the facial nerve were found in 45 ears of 24 cases, including dehiscence in geniculate fossa in 25 ears, anteromedial displacement at the beginning site in 27 ears (widening of Bill's bar in 7 cases), enlargement of the angle of the first genu in 30 ears with an average value of 107.2° (96.0–126.0°), increase of length in 30 ears with an average length of 6.8 mm (5.2–8.3 mm) and bifurcation in one ear. Associated middle ear malformation in 6 ears and inner ear malformation in 36 ears were also found.
Conclusion: A variety of congenital variations may occur in the labyrinthine segment of the facial nerve and they are often associated with middle or inner ear malformations, which can be clearly displayed by HRCT with MPR or CPR images.

Fallopian canal is an important anatomical landmark in temporal bone surgeries featured by frequent anatomical variations and close connection with iatrogenic injuries. Sufficient knowledge of the orientation and adjacent structures of the facial nerve in the temporal bone is a precondition for surgeries. In contrast to a number of reports on the normal anatomy of fallopian canal and the malformations of the tympanic and mastoid segments of the facial nerve [1–5], only limited studies are devoted to the variations in the labyrinthine segment of the facial nerve. We discussed the high-resolution computed tomography (HRCT) appearance of variations in the labyrinthine segment of the facial nerve and the associated inner and middle ear malformations.

* Corresponding author.
E-mail address: xupeng201408@126.com (P. Xu).

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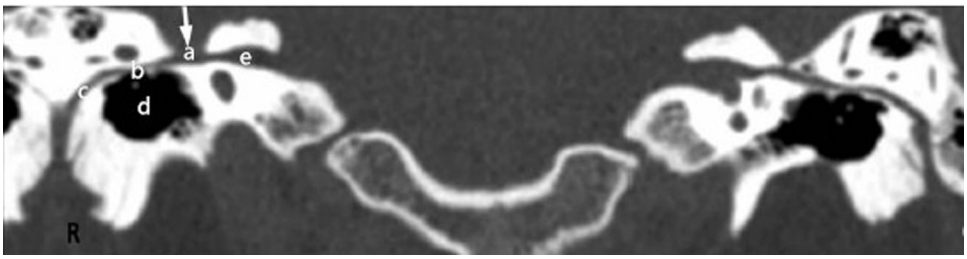

Fig 1. Dehiscence of fallopian canal at the labyrinthine segment. On the coronal CPR image of the facial nerve, the arrow indicated dehiscence in the labyrinthine segment on the right whereas the left side was normal. (a) labyrinthine segment of the facial nerve; (b) tympanic segment of the facial nerve; (c) mastoid segment of the facial nerve; (d) middle ear cavity; (e) internal auditory canal.

1. Materials and method

1.1. Clinical data

HRCT images of the temporal bones taken for hearing loss from March 2006 to March 2016 in our hospital were reviewed. Variations in the labyrinthine segment of the facial nerve were found in 24 cases (11 males and 13 females, aged 2–24 years, 10 ± 6.5 years on average). The associated symptoms included bilateral or unilateral hearing loss, microtia and ankylotia, in the absence of other neurological signs. These cases were diagnosed as sensorineural deafness or conductive deafness. The length of labyrinthine segment of the facial nerve and angle of the first genu of 10 normal subjects (4 males and 6 females, aged 13 ± 5.6 years) were also measured.

1.2. Scan procedures

Phillips MX8000 CT scanner was used. The scan parameters were as follows: 120 kV, 200 mA, pitch 0.875, collimation 0.625 mm, reconstruction interval 0.20 mm, 512×512 scanning matrix, 1024×1024 reconstruction matrix, using bone remodeling algorithm.

1.3. Image postprocessing and analysis

Phillips EBW Workstation was used for image postprocessing. Axial CT images were observed for possible lesions or anatomical variations. After that, multi-planar reformation (MPR) and curved-planar reformation (CPR) images of bilateral ossicular chains, inner ear structure and fallopian canal were reconstructed. The length of the labyrinthine segment, i.e., the distance from the inner margin of Bill's bar to the geniculate fossa, was measured from the axial CPR image. The angle of the first genu, i.e., the angle formed between the tympanic segment and the long axis of the labyrinthine segment with the center of the geniculate fossa as the vertex, was measured. Then the beginning site of the labyrinthine segment, dehiscence, and middle and inner ear malformations were observed from the axial, coronal and sagittal CPR images, respectively.

1.4. Statistical analysis

SPSS 16.0 software was employed for analysis. t-test was used to compare means between two groups, and $p < 0.05$ indicated significant difference.

2. Result

Five types of variations in the labyrinthine segment of the facial nerve were found on 45 ears of 24 cases, including: dehiscence in geniculate fossa (Fig. 1) in 25 ears, anteromedial displacement at the beginning site (Fig. 2) in 27 ears (sometimes with widening of Bill's bar in 7 cases), enlargement of the angle of the first genu (Fig. 2) in 30 ears with an average value of $107.2 \pm 6.8°$ (96.0°–126.0°), increase of length in 30 ears with an average length of 6.8mm ± 0.38(5.2–8.3 mm) and bifurcation (Fig. 3) in 1 ear. Associated middle ear malformation and

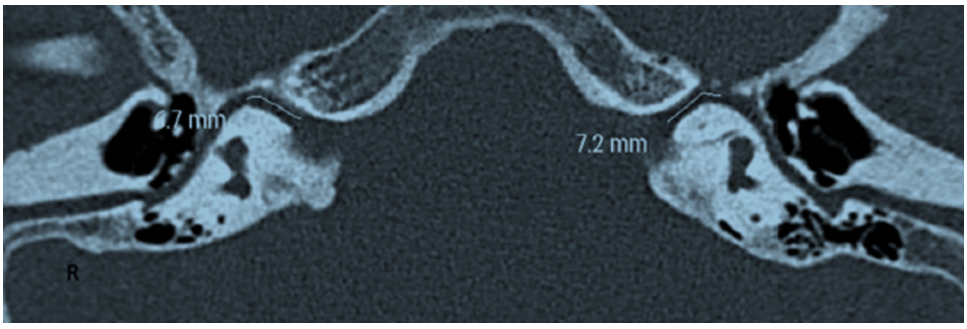

Fig. 2. Anteromedial displacement of facial nerve at the labyrinthine segment. Axial CPR image indicated anteromedial displacement of the beginning site of the fallopian canal, with an increased length (white line) (right: 6.7 mm; left: 7.2 mm).

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