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ORIGINAL ARTICLE

Effect of Semicircular Canal Dehiscence on Contralateral Canal Bone Thickness☆

Borja Gracia-Tello,[a] Ana Cisneros,[a] Rafael Crovetto,[b] Claudio Martinez,[c] Olívia Rodriguez,[d] Iñigo Lecumberri,[e] Miguel Ángel Crovetto,[f] Jaime Whyte[a,*]

[a] *Departamento de Anatomía e Histología Humanas, Universidad de Zaragoza, Zaragoza, Spain*
[b] *Departamento de Estomatología, Universidad del País Vasco, Leioa, Vizcaya, Spain*
[c] *Servicio de Radiología, Hospital General de la Defensa, Zaragoza, Spain*
[d] *Servicio Radiología Clínica, Hospital de Cruces, Baracaldo, Vizcaya, Spain*
[e] *Servicio de Radiología, Hospital de Basurto, Bilbao, Vizcaya, Spain*
[f] *Servicio de Otorrinolaringología, Hospital de Basurto, Bilbao, Vizcaya, Spain*

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KEYWORDS
Dehiscence;
Superior or posterior semicircular canal;
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Abstract
Objectives: Our objective was to determine if the existence of dehiscence in the superior or posterior semicircular canal was associated with the thinning of the bone roof in the rest of the vertical canals (superior or posterior).
Methods: The thickness of the superior and posterior semicircular canals contralateral to a dehiscence was studied using computerized tomography and compared statistically.
Results: When a superior semicircular canal had a dehiscence, the contralateral canal showed a significant mean decrease in its thickness of 0.5 mm (SD: 0.3 mm). This was not the case if the dehiscence was in the posterior semicircular canal, where the thickness of 2.1 mm remained unchanged (SD: 1.2 mm; *P*=.49).

When a posterior semicircular canal showed dehiscence, no significant thinning was shown in the superior semicircular (1 mm; SD: 0.4) or in the posterior contralateral (1.3 mm; SD: 0.3) canals.
Conclusion: The existence of a dehiscence in the superior semicircular canal is associated with bone thinning in the canal on the opposite side, but not with the posterior semicircular canal. In contrast, if the dehiscence is in the posterior semicircular canal, contralateral and superior canal thickness is not modified.

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* Corresponding author.
E-mail address: jwhyte@unizar.es (J. Whyte).

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PALABRAS CLAVE
Dehiscencia;
Canales semicirculares superior y posterior;
Adelgazamiento óseo

Influencia de la existencia de una dehiscencia en un canal semicircular en el espesor óseo de los canales contralaterales

Resumen
Objetivos: Determinar si la existencia de un canal semicircular superior o posterior dehiscente se asocia con el adelgazamiento de la cubierta ósea en el resto de los canales verticales (superior o posterior).
Métodos: Se estudia mediante tomografía computarizada y se compara estadísticamente el espesor de los canales semicirculares superiores y posteriores contralaterales a una dehiscencia.
Resultados: Cuando un canal semicircular superior presentaba una dehiscencia, el canal contralateral mostraba un adelgazamiento significativo de su espesor con una media de 0,5 mm (DE: 0,3 mm). No sucede lo mismo con los posteriores que no modifican su grosor de 2,1 mm (DE: 1,2 mm; p = 0,49).

Cuando un canal semicircular posterior presentaba dehiscencia no se observó adelgazamiento significativo en los canales semicirculares superiores 1 mm (DE: 0,4), ni en el posterior contralateral 1,3 mm (DE: 0,3).
Conclusión: La existencia de una dehiscencia del canal semicircular superior se asocia al adelgazamiento del hueso del canal del lado contrario, pero no de los canales semicirculares posteriores. No ocurre lo mismo si la dehiscencia es del canal semicircular posterior, que no altera de manera significativa el espesor del canal del lado contralateral ni en los superiores.

Introduction

At present, the aetiology of semicircular canal dehiscence is not yet fully known, although various theories have been postulated. Tsunoda and Terasaki[1] suggested that dehiscence is due to a defect in embryonic development by malposition of the primitive otocyst. Crovetto et al.[2] linked it with a defect in bone reorganisation of the channel during the prenatal period. Zhou et al.[3] linked it to a canal defect due to abnormal development of the middle cranial fossa. Carey et al.[4] and Teixido et al.[5] linked it to a postnatal alteration of the top of the canal and Mikulec et al.[6] to a congenital predisposition. Other hypotheses have suggested that dehiscence occurs by a rupture of the coverage of extremely fine canals caused by cranial trauma,[7] a sudden increase in intracranial pressure[8] or erosion caused by the weight and pressure of the temporal lobe.[9] Recently, Nadgir et al.[10] investigated whether superior canal dehiscence was congenital or acquired. After observing that prevalence increased with age, they suggested that the most common origin was acquired, rather than congenital.

We performed a study of patients with radiological dehiscence in a vertical semicircular canal (superior or posterior). We analysed the mean thickness of the cover of the other vertical canals to verify whether a pathological condition of the former determined variations in the mean thickness of the latter. We took normal values as reference and established their correlation.

Material and Methods

The study was conducted at 3 healthcare centres: Hospital de Basurto, Hospital de Cruces and Hospital General de la Defensa, in Zaragoza, between September 2007 and March 2008. The study was approved by the Ethics Committees of the respective centres according to the guidelines of the Helsinki Declaration of 1964. All patients were informed about the study and signed the relevant informed consent forms.

The study was conducted on consecutive patients, selected from those attending the radiology departments of these hospitals to undergo a computed tomography (CT) scan of the temporal bones for various reasons (hearing loss, facial paralysis, vertigo, tinnitus, chronic otorrhea, deep otodynia). CT scans were reviewed by 3 radiologists with over 10 years of experience in neuroradiology, one for each hospital.

We excluded patients with any type of anatomical alteration of the labyrinth. We also excluded all those patients whose CT scans did not have sufficient quality to determine the parameters under study.

All studies were performed with helical, multi-slice CT devices, obtaining images in the axial plane and with the neck in hyperextension in order to avoid direct radiation on the ocular lens. Subsequently, we conducted coronal reconstructions and in the plane of the superior semicircular canal (SSC) of each ear and in axial sections for the posterior semicircular canals (PSC). The ''raw data'' were reconstructed using a bone algorithm.

In all temporal bones we measured the minimum thickness covering the roof of the SSC and the middle cranial fossa, as well as the minimum thickness of the PSC and the posterior cranial fossa. We defined the minimum thickness of the bone covering the SSC as the thinnest point of bone observed in the CT scan obtained in the same plane as the canal (Pöschl) between the outer surface of the SSC and the free surface of the middle cranial fossa. We defined the minimum thickness of bone covering the PSC as the thinnest point of bone observed in the axial sections of the CT scan between the PSC and the intracranial space.

We used the following radiological protocols for the acquisition and formatting of images: collimation 2 mm $\times$ 0.6 mm, section thickness 0.65 mm, section increase