

# The Roof of the Labyrinthine Facial Nerve Canal and the Geniculate Ganglion Fossa on High-Resolution Computed Tomography: Dehiscence, Thickness and Pneumatization

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**Abstract:** The labyrinthine segment of facial nerve canal and the geniculate ganglion fossa are two important landmarks in the middle cranial approach for acoustic neuromas removal. Their roof is drilled during this approach. The aim of the study was to appreciate the roof of these two structures on high-resolution computed tomography. To achieve this purpose, we used computed tomography examinations of 194 healthy adult petrous bones, selected within a period of one year. They represented 97 subjects with a mean age of 49.3 years. The computed tomography machines were *Siemens®* "SOMATOM Definition AS + Fast Care", 128 slices. The appreciated variable were the presence or absence of a dehiscence, the thickness of the bone (mm), and the pneumatization of the bone (presence of aerated cells in the bone) or not (dense bone with total absence of aerated cells). We determined for each of these variables, the mean (mm), the standard deviation, the ranges (minimum, maximum). The paired Student's *t*-test was used to compare the means of the variables according to gender (male-female), and side (right-left). We obtained the following results for the roof of the labyrinthine facial canal: all the canals (100%) were covered, 104 cases (53.6%) were pneumatized. The mean thickness of the bone was 3.86 mm  $\pm$  2.06, ranges 0.22 - 9.95 mm. Without male-female difference ( $p = 0.99$  and  $p = 0.30$ ), nor right-left difference ( $p = 0.07$ ). For the geniculate ganglion fossa, 62 cases (31.96%) were dehiscent. One hundred and eight cases (81.81%) of the 132 covered cases were pneumatized. The mean thickness of the bone was 3.01 mm  $\pm$  1.87, ranges 0.36 - 9.12 mm. There was no male-female ( $p = 0.68$  and  $p = 0.94$ ) or left-right difference ( $p = 0.49$ ). Our results therefore lead us to conclude that osseous covering of the geniculate ganglion is more prone to dehiscence and pneumatization than that of the labyrinthine facial canal, and thus presents more risks during surgery because of its fragility. So, we think that the bony covering should be studied for every patient in the event of middle fossa approach.

**Keywords:** Labyrinthine Facial Canal, Geniculate Ganglion Fossa, Roof, Dehiscence, Pneumatization, Bone's Thickness, High-Resolution Computed Tomography

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## 1. Introduction

Intra-canal vestibular schwannomas (neurilemmomas), initial stage of these tumours within the internal auditory canal before their extension in the cerebello-pontine angle, are tumours that the surgeon can resect through the middle cranial fossa approach. The technique described by William F. House in 1961 allows the surgeon to access to the internal auditory canal after successively drilling in reverse manner, the roofs of: the greater superficial petrosal nerve canal, the geniculate ganglion fossa and finally the labyrinthine segment of the facial nerve canal [1].

In this approach, the labyrinthine segment of the facial nerve and the geniculate ganglion are exposed to trauma [1-7]. These incidents can occur during the drilling of the roof of their osseous containers, when the bone is thin or pneumatized (non-dense bone). Incidents will occur especially when there is a dehiscence of the osseous covering, which leaves these nervous structures below exposed to trauma.

In order to avoid injuries to the labyrinthine facial nerve and the geniculate ganglion in this approach of the internal auditory canal using the House technique, it is important for the surgeon to have information's concerning their osseous covering, in advance, when planning the procedure. Pre-operative knowledge on the presence or absence of dehiscence, the thickness of the bone and its pneumatization, could guide the surgeon during the drilling process. Adequate information about this bony covering can be obtained with high-resolution computed tomography.

Several studies have been conducted on the prevalence of dehiscence of the facial canal and the geniculate ganglion: anatomical [8, 9], histological [10, 11], radiological [12, 13] and surgical studies. For the radiological series, available studies on the prevalence of facial canal dehiscence on computed tomography were performed on the facial canal in its entirety, including all its three segments (labyrinthine, tympanic and mastoid). Radiological studies about the dehiscence of the labyrinthine segment alone are not available. On the other hand, the available radiological studies on computed tomography are carried out on small samples of labyrinthine facial canals.

Unlike the labyrinthine facial canal, data about the dehiscence of the geniculate ganglion on computed tomography are found in the literature. However, these studies were carried out either on pathological temporal bones, either on small samples, or both. Jin *et al.* conducted a study on the geniculate ganglion dehiscence on a small sample of 45 temporal bones, from patients suffering from deafness [13].

Radiological studies on the geniculate ganglion fossa dehiscence in normal conditions (healthy temporal bones), using large samples sizes, are not available.

The thickness and pneumatization of the bone covering the labyrinthine facial nerve and the geniculate ganglion are not topics broached in literature.

This data provides preoperative orientations that the surgeon must take into consideration when planning the internal auditory canal approach using the House technique, to ensure safe gestures.

The aim of this study was to provide the prevalence of dehiscence of the labyrinthine facial nerve canal and the geniculate ganglion fossa on high-resolution computed tomography, on a larger sample size, with normal temporal bones. Similarly, for the part of this bone overlying and protecting the aforementioned two nervous structures, we studied two variables not yet reported in the literature. We provided the prevalence of its pneumatization (presence or absence of aerated cells in the bone) and we measured its thickness.

The results obtained were compared to those of previous studies available in literature, including radiological, anatomical, surgical and histological series.

## 2. Materials and Methods

### 2.1. Study Design

We carried out a retrospective and descriptive study, in the Imaging Unit of the Teaching Hospitals of Hautepierre at Strasbourg in France. The period of recruitment covered one year, from the 1<sup>st</sup> January to the 31<sup>st</sup> December 2016.

### 2.2. Materials

#### 2.2.1. Materials of Study

The authors used the computed tomography slices of 194 healthy petrous bones (97 adult persons), recruited in the database of the Imaging Unit of the University Hospitals of Hautepierre. They represented 45 males and 52 females (male/female sex ratio: 0.86), with a mean age of 49.3 years, (range 18-83 years).

#### 2.2.2. Criteria of Selection

We included in our sample, the computed tomography images of all healthy petrous bones of adult subjects, for whom examinations were done within the period of study, in the Imaging Service of the University Hospitals of Hautepierre. They were "all-comers" patients, randomly selected.

Petrous bones of all the subjects who presented neurological signs such as facial palsy, hearing lost or any other neurological sign were not included in the sample, as well as all pathological petrous bones (either traumatic, infectious or neoplastic pathology). We didn't also included in our sample, the petrous bones of all non-adult patients.

#### 2.2.3. Imaging Devices

The scanners used were *Siemens®*, "SOMATOM Definition AS + Fast Care" model, with 128 slices. The working computers were *Apple®*, "MacIntosh" model. The images were selected and processed with the medical imaging software "OsiriX".

## 2.3. Methods

### 2.3.1. Imaging Protocol

The protocol used for the acquisition of petrous bones images is summarized in Table 1, and the post-treatment

protocol is summarized in Table 2. Native images were processed to obtain particular planes in which the different variables were studied, and data was analysed using the statistical analysis software "SPSS 18.0".

**Table 1.** Protocol used for computed tomography (CT) acquisition of petrous bones.

Parameter	Value and recommendation	
Patient installation	Supine position, head in hyperflexion	
Explored zone	From the internal acoustic meatus to the outlet of the petrous bones	
Scout View		
Voltage	120 kV	
Intensity	36 mAs	
CT Parameters		
Voltage	140 kV	
Intensity	400 mAs	
Number of Detector	16	
Thickness of the nominative cuts	0.3 mm	
Thickness of the reconstructed cuts	0.4 mm	
Interval of reconstruction	0.1 mm	
Pitch	0.45	
Filter of reconstruction	U 75 very hard ASA	
Windows W/L	4000 / 700 UH	
Delay	2	
Reconstructions		
	Right petrous bone	Left petrous bone
Thickness of the cuts	0.4 mm	0.4 mm
Interval of reconstruction	0.1 mm	0.1 mm
Filter of reconstruction	U 75 very hard ASA	U 75 very hard ASA
Window W/L	4000 / 700 UH	4000 / 700 UH
CTDI Volume	132 mGy	

**Table 2.** Post-treatment of computed tomography images of petrous bones.

Plane of reconstruction	Slice thickness and number of images
Axial Reconstruction	60 images
	0.4 mm of thickness of the image
	0.3 mm of distance between images
Sagittal Reconstruction	60 images
	0.4 mm of thickness of the image
	0.3 mm of distance between images
Coronal Reconstruction	60 images
	0.4 mm of thickness of the image
	0.3 mm of distance between images
Zoom 10	60 images
	0.4 mm of thickness of the image
	0.2 mm of distance between images
VO	5 images
	0.4 mm of thickness of the image
	0.2 mm of distance between the images

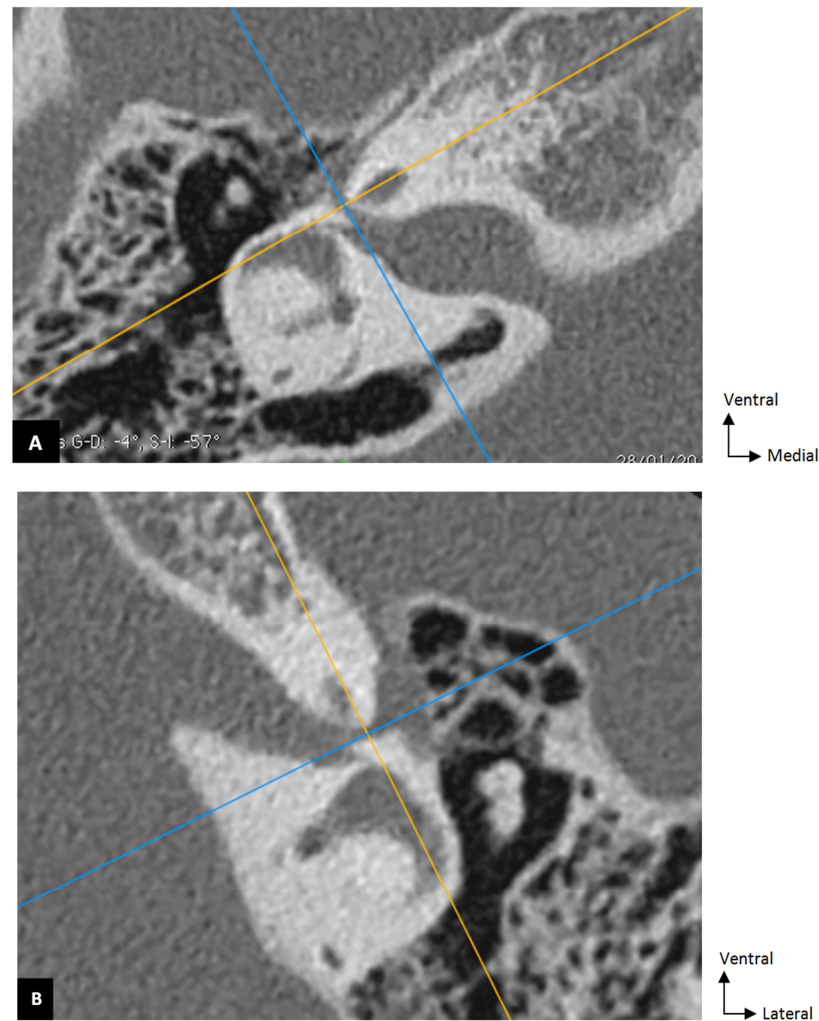
### 2.3.2. Studied Variables

We studied the osseous covering of the two cavities, their roof. We appreciated concerning this covering:

- 1) the presence or absence of a dehiscence;
- 2) the thickness of the bone (mm);
- 3) the pneumatization of the bone (presence of aerated cells in the bone), or not (dense bone with total absence of aerated cells).

### Planes of study

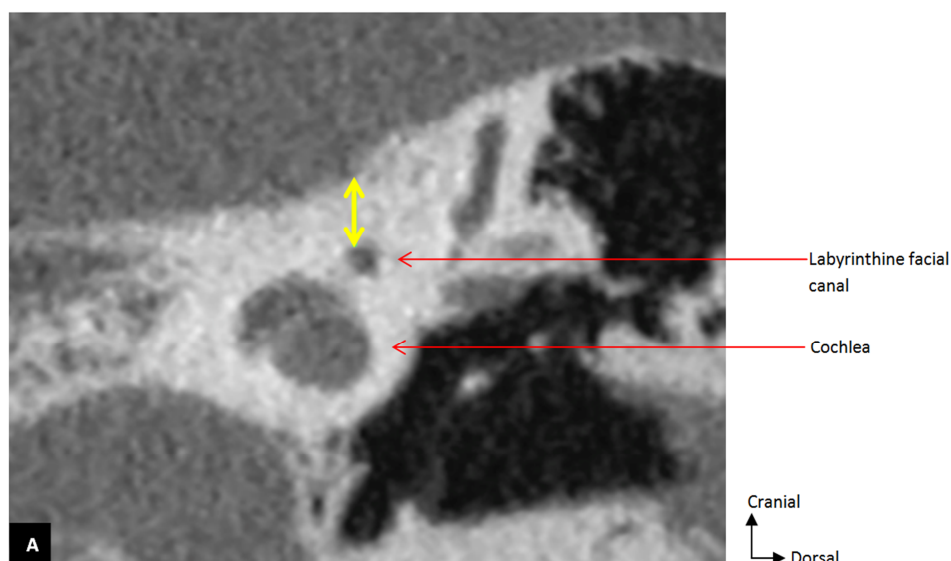
All the petrous bones were first fixed in the basic axial plane, used for the study of the temporal bone. This plane is parallel to the lateral semi-circular canal. An axial slice of petrous bones of good quality should highlight on the same image: the ring of the lateral semi-circular canal, the head of the malleus, the body of the incus, the cochlea and the tympanic segment of the facial canal (Figure 1).



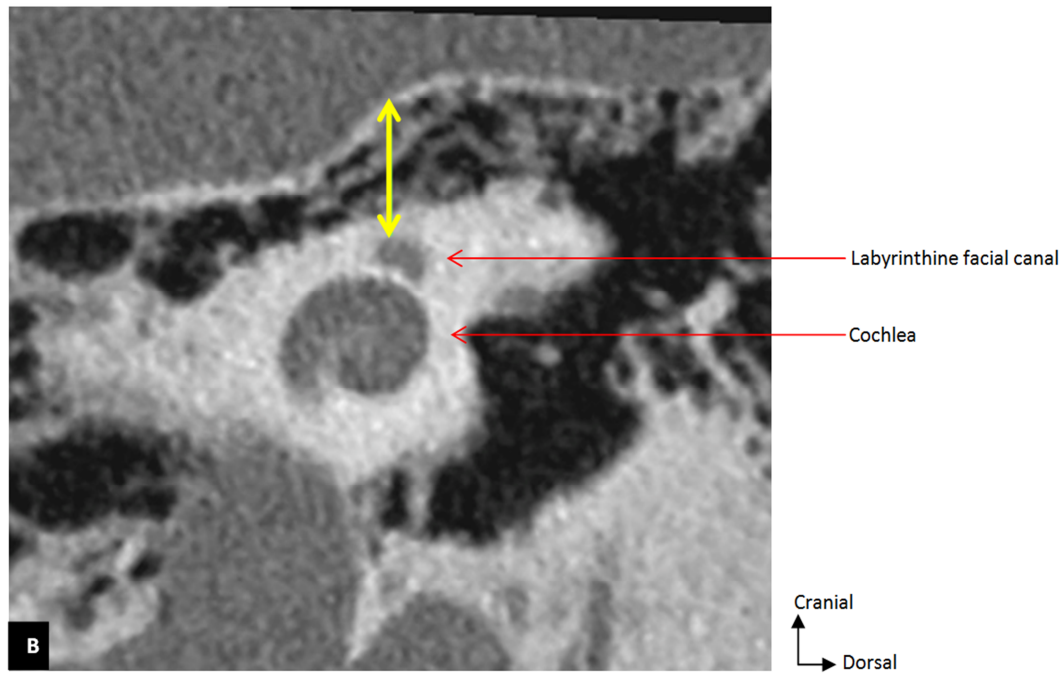
**Figure 1.** Axial slices of petrous bones parallel to the lateral semi-circular canal, used to study the labyrinthine segment of the facial nerve canal and the geniculate ganglion fossa.

These slices highlight on the same image, the ring of the lateral semi-circular canal, the head of the malleus, the body of the incus, the cochlea and the tympanic facial canal. A. Right petrous bone; B. Left Petrous bone.

The blue line is the coronal plane of cut passing through the axis of the facial canal. The yellow line is the oblique sagittal plane of cut oriented along the greater axis of the temporal bone.







A. Unpneumatized bone cover; B. Pneumatized bone cover.

**Figure 2.** Appreciation of the pneumatization and the measurement of the thickness of the osseous covering of the labyrinthine facial canal on an oblique sagittal slice of the petrous bone.

The osseous covering of the labyrinthine facial canal and its thickness were appreciated, and measured in oblique sagittal reconstructions, parallel to the great axis of the petrous bone. We measured the highest height on these slices (Figure 2). The dehiscence was searched for two planes, the axial and the oblique sagittal (Figure 2).

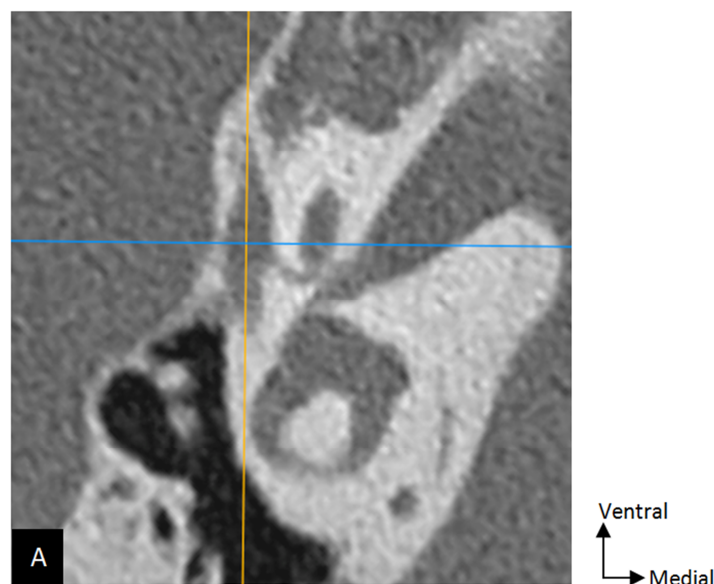
The labyrinthine facial canal is related to the following structures in this sagittal plane:

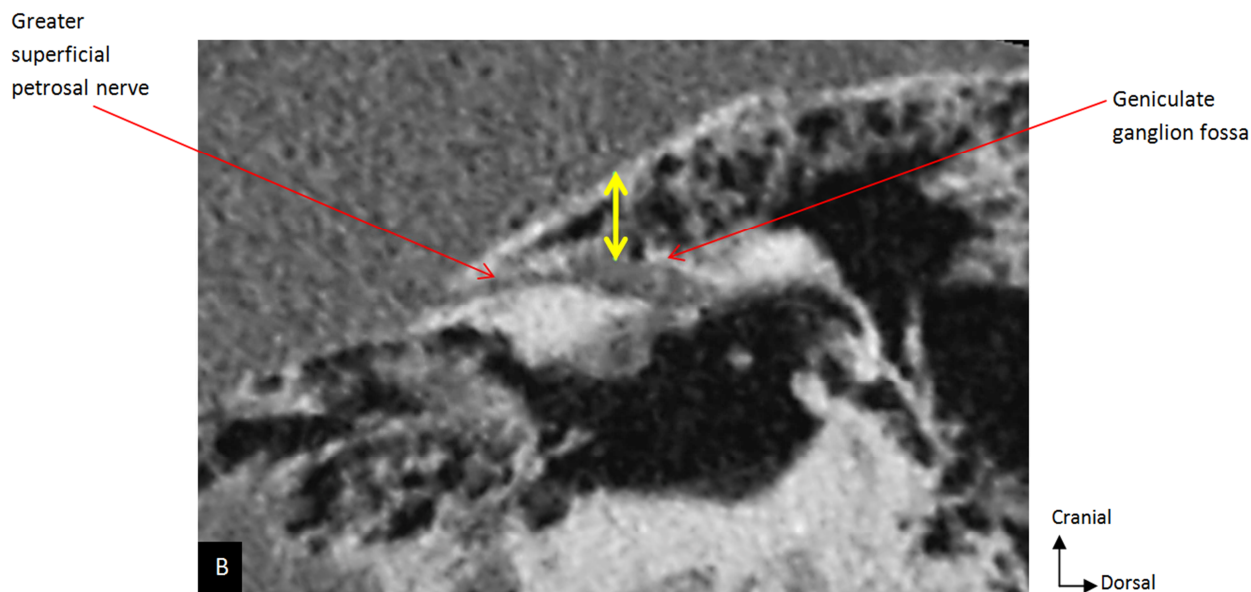
- 1) in front: the first turn of the cochlea;
- 2) behind: the vestibule with the ampoules of the superior and lateral semi-circular canal;
- 3) above: the roof of the petrous bone.

The covering of the geniculate ganglion fossa was appreciated and measured in sagittal reconstructions, passing through its axis (Figure 3). We measured the highest height in this plan. Dehiscence of the roof of the geniculate ganglion fossa was searched for two planes, the axial and the sagittal (Figure 4).

The geniculate ganglion fossa is related to the following structures on the plane:

- 1) in front: the second and third turns of the cochlea;
- 2) behind: the antero-lateral angle of the vestibule;
- 3) above: the roof of the middle cranial fossa;
- 4) below: the basal turn of the cochlea.





**Figure 3.** A. Orientation of the sagittal plane of cut for the study of the roof of the geniculate ganglion fossa, on an axial slice of petrous bone.

The yellow line is the sagittal plane of cut, passing through the axis of the geniculate ganglion fossa, used for the appreciation of its bony covering.

B. Appreciation of the pneumatization and measurement of the thickness of the bony covering of the geniculate ganglion fossa on a sagittal slice of the petrous bone.



**Figure 4.** A and B. Illustrations of a partial absence of the bony covering of the geniculate ganglion.

The roof of the fossa is replaced here by dura-matter. A. Axial plane, B. Sagittal plane.

C. Illustration of a complete absence of geniculate ganglion fossa covering on an axial cut of the petrous bone.

In all the three cases, we note an absence of the greater superficial nerve canal.

**Table 3.** Thickness of the roof of the labyrinthine facial canal according to sex and side.

	Thickness of the roof of the labyrinthine facial canal (n = 194)			
	Sex		Side	
	Male (n = 90)	Female (n = 104)	Right petrous bone (n = 97)	Left petrous bone (n = 97)
Mean (mm)	3.73	3.98	3.67	4.05
Minimum (mm)	0.22	0.25	0.22	0.36
Maximum (mm)	8.68	9.95	9.71	9.95
Standard deviation	1.86	2.23	2.10	2.01
p-value	p on the left side: 0.99 p on the right side: 0.30		0.07	

**Table 4.** Thickness of the roof of geniculate ganglion fossa according to sex and side.

	Thickness of the roof of the geniculate ganglion fossa (n = 132)			
	Sex		Side	
	Male (n = 60)	Female (n = 72)	Right petrous bone (n = 65)	Left petrous bone (n = 67)
Mean (mm)	2.95	3.06	3.08	2.93
Minimum (mm)	0.36	0.37	0.48	0.36
Maximum (mm)	9.12	7.84	9.12	7.79
Standard deviation	1.96	1.81	0.48	0.36
p-value	p on the left side: 0.61 p on the right side: 0.51		0.75	

### 2.3.3. Analysis of the Data

We determined the following parameters for each variable studied:

- 1) for the dehiscence of the two cavities and the pneumatization of the bone: we determined the prevalence;
- 2) for the thickness of the bone we determined: the mean (mm), the standard deviations, the range (minimum, maximum). The median was used for very wide ranges, or high standard deviations.

The paired Student's *t*-test was used to compare the means of the different parameters according to gender (male-female) on one hand, and the side (right-left) on the other hand. The difference between two means is considered as significant when the *p*-value obtained is less than the threshold value of 0.05.

## 3. Results

### 3.1. Labyrinthine Segment of the Facial Nerve Canal

For the osseous covering of the labyrinthine segment of the facial canal, all the canals (100%) that we studied were covered.

One hundred and four bones (53.6%) were pneumatized, and the 90 others (46.4%) were not pneumatized.

The mean thickness of the osseous covering of the labyrinthine facial canal was 3.86 mm  $\pm$  2.06, range 0.22 - 9.95 mm. Its median was 3.73 mm.

There was no significant difference between the mean thicknesses of the osseous covering of male's facial canals (3.73 mm) and female's facial canals (3.98 mm), *p* = 0.99 on the left and *p* = 0.30 on the right.

Likewise, there was no significant difference between the mean thicknesses of the roof of right facial canals (3.67 mm) and left facial canals (4.05 mm), *p* = 0.07. Table 3 summarizes the results of roof of the labyrinthine facial canals.

### 3.2. Geniculate Ganglion Fossa

For the geniculate ganglion fossa, 132 cases (68.04%) were covered and 62 cases (31.96%) were dehiscence (partial and complete dehiscence observed in our study is illustrated in Figure 4).

Concerning the pneumatization of the osseous covering, 108 of the 132 covered fossae (81.81%) were pneumatized. The remaining 24 cases (18.19%), were non-pneumatized, presenting an entirely dense bone, covering the geniculate ganglion fossa.

The mean thickness of the roof of the geniculate ganglion fossa was 3.01 mm  $\pm$  1.87, range 0.36 - 9.12 mm. The median was 3.52 mm.

There was no significant difference between the mean thicknesses of the roof of male's fossae (2.95 mm) and female's fossae (3.06 mm): *p* = 0.61 on the left and *p* = 0.51 on the right.

Similarly, there was no significant difference between mean thicknesses of the osseous covering of right fossae (3.08 mm) and left fossae (2.93 mm), *p* = 0.75. Table 4 summarizes the results of osseous covering of the geniculate ganglion fossa.

## 4. Discussion

Our recruitment having been made from the database of a university hospital for "all comers" patients, our sample is thus random.

For the thickness of the roofs of the two cavities, there was no significant difference neither left-right, nor male-female. This signifies that our results are representative of the two petrous bones of any adult subject without malformation, both men and women.

High-resolution computed tomography is the main imaging exam used in the study of the cavities and canals of the temporal bone [14, 15]. It is the most appropriated

examination to reveal dehiscence of the facial nerve canal and geniculate ganglion fossa [14].

The basic plane recommended for the study of the petrous bone is the axial plan parallel to the semi-circular canal [14, 16]. We used this plane in our study to provide the best exploration possible while avoiding irradiation of the lens of the eye [14, 16]. This plane of acquisition should pass above the orbits in front and through the petrous bones behind [14]. The oblique sagittal plane, parallel to the great axis of the petrous bone is the most appropriate for studying the labyrinth [14].

The scan parameters that we used were in the ranges of those used by authors in the literature [12-15, 17].

#### **4.1. Labyrinthine Segment of the Facial Nerve Canal**

##### **4.1.1. Dehiscence**

In literature, the presence of the osseous covering of the labyrinthine segment of the facial canal is not constant according to authors.

All the labyrinthine facial canals we studied (100%) had a bony covering. No case of dehiscence was found. This results that we obtained is similar to those of some radiological studies [13, 18], which show that the lack of the osseous covering of the labyrinthine facial canal is a rare abnormality.

Indeed, in an anatomical study, Ge and Spector on a small sample of 10 dissected temporal bones, showed that all the 10 labyrinthine facial canals were covered with bone. No area of dehiscence was observed [19].

In a prospective non-randomized study, Di Martino *et al.* appreciated the prevalence of the dehiscence of the facial nerve canal in two contexts [18]. In a surgical series, the first context, they appreciated the prevalence of dehiscence discovered intraoperatively during 357 routine ear procedures. In an anatomical series, the second context, they appreciated the prevalence of dehiscence observed during the autopsies of a sample of 300 temporal bones. The results were as follows: 01 case of dehiscence found intraoperatively within the 357 operated temporal bones, and 03 dehiscent labyrinthine facial canals among the 300 autopsied temporal bones [18].

Jin *et al.* report a more elevated prevalence of the dehiscence of the labyrinthine facial canal. In a radiological study, they reported a prevalence of the dehiscence of 10% [13]. This great discrepancy between their results, ours, and those of other authors, can be explained by the fact that in their study, Jin *et al.* considered the geniculate ganglion fossa as a part of the labyrinthine facial canal, hence they mixed together the results of these two structures. Their working method led to an increase of the number of cases of dehiscent labyrinthine facial canals.

##### **4.1.2. Pneumatization and Thickness**

We did not find any result concerning these aspects in the literature. The bone overlying the labyrinthine facial canal was pneumatized in 104 of the 194 facial canals that we studied (53.6%).

In literature, the thickness of the roof of the labyrinthine

facial canal when present is not measured. Therefore, data concerning its thickness and pneumatization are not found. The mean thickness in our study was 3.86 mm, with extreme values ranging from 0.22 mm to 9.95 mm.

#### **4.2. Geniculate Ganglion Fossa**

##### **4.2.1. Dehiscence**

Data concerning the osseous covering of the geniculate ganglion also bears much variation according to authors and studies. However, the dehiscence of the geniculate ganglion fossa appears to be more frequent than that of the labyrinthine facial canal.

Indeed, in a surgical study, Crabtree and House report 5% of dehiscent fossae where the geniculate ganglion is exposed without osseous covering, among their patients undergoing an exposure of the internal auditory canal through the middle cranial fossa approach [4].

In an anatomical study conducted by Rhoton *et al.* on 100 petrous bones, all or a part of the geniculate ganglion and the genu of the labyrinthine facial nerve were exposed in 15 cases (15%); among the 15 cases, the geniculate ganglion was totally exposed in 02 cases (2%) [8].

Hall *et al.* carried out an anatomical study, also on 100 temporal bones, and they had similar results as Rhoton *et al.* They showed that 15 geniculate ganglions (15%) had no or incomplete bony covering. And among these 15 cases, 02 had the entire width of the geniculate ganglion exposed [9].

In his histological study of the geniculate ganglion, Dobozi showed 05 cases of dehiscence in a sample of 24 temporal bones [10]. Rupa *et al.* in another histological study on 11 temporal bones, reported that the bone overlying the geniculate ganglion was absent in 01 specimen [11].

A 14.5% prevalence of geniculate ganglion dehiscence in a sample of 365 temporal bones is reported by Isaacson and Vrabec in their radiological study on computed tomography [12]. This difference between their results and ours can be explained by the fact that, for the study of the roof of the geniculate ganglion fossa, Isaacson and Vrabec used a reconstruction plan of the images, different from ours. They used coronal reconstructions, while we used sagittal reconstructions passing through the great axis of the geniculate ganglion in our study. This plane of reconstruction that we used allows better appreciation of the bone overlying the geniculate ganglion fossa throughout its all length. It is the plan recommended by many authors such as Veillon for the radiological examination of the geniculate ganglion fossa [14, 16]. In addition, they mixed in their sample both normal and congenitally thin temporal bones, while we selected only normal temporal bones [12].

Ge and Spector found in an anatomical study on a sample of 10 temporal bones randomly selected, that all the geniculate ganglion fossae were completely ossified [19]. Although for two of these cases, the osseous plate was thin enough to see the geniculate ganglion below.

A more elevated value is reported by Jin *et al.* in their radiological study on 48 temporal bones, where almost the

half of the cases, 25 geniculate ganglions, present a dehiscence [13]. Let us recall, however, that in their study, they considered the geniculate ganglion fossa as part of the labyrinthine facial canal and they mixed the values of the two structures.

#### **4.2.2. Pneumatization and Thickness of the Roof of the Geniculate Ganglion Fossa**

We did not find any figures in the literature to compare the pneumatization and the thickness of the roof of the geniculate ganglion fossa. This pneumatization in our study was highlighted in 108 cases (81.81% of the covered geniculate ganglions). The mean thickness of the covering of the geniculate ganglion was 3.01 mm, with extreme values ranging from 0.36 mm to 9.12 mm. The median was 3.52 mm.

#### **4.3. Surgical Implications**

Described by William F. House in 1961, this approach gives access to the internal auditory canal and its contents through its roof extradurally. It's an approach used for the removal of acoustic neuromas, mostly the intracanalicular tumours. During the procedure the bony covering of the geniculate ganglion fossa and the labyrinthine facial canal is carefully dug with a small diamond bur.

Pre-operative knowledge of the characteristics of the bony covering helps to envision the resistance of the bone. This will guide the drilling and avoid per-operative injuries. Therefore, the pre-operative research on high resolution computed tomography of a dehiscence of the roof of the labyrinthine facial canal and/or the geniculate ganglion lodge, as well as the assessment of the thickness and the pneumatization of the bone protecting these nerve structures, are important prerequisites for the planning of the surgical procedure.

The mean thickness of the roof of the geniculate ganglion fossa in our study is 3.01 mm  $\pm$  1.87, with wide extremes ranging from 0.36 mm to 9.12 mm. This confirms to us the necessity of the pre-operative measurement on every patient. Furthermore, the bone covering the geniculate ganglion fossa is pneumatized in 81.81% of the cases when it is present. Therefore, this bone is in most cases of low resistance (weak), and the risk of injury is great.

The assessment of the roof of the labyrinthine facial canal by pre-operative computed tomography, makes it possible to appreciate the thickness and the density of the bone to be drilled, thus preventing trauma to the facial nerve.

The mean thickness of the roof of the labyrinthine facial canal in our study is 3.86 mm ( $\pm$  2.06 mm), with wide extremes ranging from 0.22 mm to 9.95 mm. We found that 53.6% of the labyrinthine facial canals have their bone covering pneumatized, therefore less often than the one of the geniculate ganglion fossa where this prevalence is 81.81%. As a result, the roof of the labyrinthine facial canal is less likely to be traumatised during the drilling than the one of the geniculate ganglion fossa.

We find this study interesting because the studied

parameters are commonly used to guide access to the roof of the internal auditory canal. These parameters allow the surgeon to understand the difficulties and risks involved in the procedure especially in case of dehiscence. So, in the event of dehiscence of the geniculate ganglion or the labyrinthine facial canal identified on the pre-operative computed tomography, House's technique can be avoided and replaced by another surgical technique to access the internal auditory canal.

#### **4.4. Limitations of the Study**

Some authors highlight conflicts (differences, divergences) in the percentages of the dehiscence of the roof of the facial nerve canal, between radiological and operative findings.

High-resolution computed tomography is the most used examination to reveal the dehiscence of the roof of the facial canal [16]. However, there is some limitations which must be recognized and because of them, some bony defects can go unnoticed on high-resolution computed tomography.

Fuse et al. conducted a study to compare the number of cases of dehiscence of the facial canal revealed by the pre-operative high-resolution computed tomography, to the number of cases of dehiscence discovered per-operatively. This retrospective study was carried out on 61 patients, by using 1 mm thick slices, spaced 1 mm apart. The plane of section was axial semi-coronal and revealed a radio-operative concordance in 75.4% of cases (46 cases out of 61). According to the same authors, these results indicate a sensibility of 66% and a specificity of 84% for high-resolution computed tomography. However, we will precise that Fuse et al. used thicker and more spaced slices in their study than us in ours (we used thinner and closer slices, 0.4 mm thickness with spacing of 0.1 mm).

By studying the radio-operative concordance for 13 cases of dehiscence of the facial canal, Yetiser [20] determined that 09 cases were identified pre-operatively by the computed tomography, while pre-operative imaging was negative for 04 cases (30.76% false negatives). Similarly, for 21 petrous bones with no dehiscence of the facial canal on the pre-operative computed tomography, a dehiscence was discovered per-operatively for 04 cases (19.04% false negatives) [20].

This probability of dehiscence of the roof of the facial canal that may go undetected on the computed tomography can be considered as a limitation for our study.

## **5. Conclusion**

Our study found that the roof of the geniculate ganglion fossa is more prone to dehiscence and pneumatization than that of the labyrinthine facial canal, and thus presents more risks during surgery because of its fragility.

The bony covering of the geniculate ganglion fossa and the labyrinthine facial canal is a structure whose characteristics (dehiscence, thickness, pneumatization) are variable, and should be studied for every patient in the

event of middle fossa approach for the removal of an acoustic neuroma.

## List of Abbreviations

CT: Computed Tomography  
CTDI: Computed Tomography Dose Index  
HR: High Resolution  
kV: kilovolt  
mAs: milliampere-second  
mGy: milligray  
mm: millimeter  
U: Unit  
HU: Hounsfield Unit  
W / L: Width / Level  
®: Trademark

## Declarations

### *Availability of Data and Materials*

Data supporting the findings of this study are available in the data base of the Imaging Unit 1 of the University Hospitals of Hautepierre at Strasbourg in France.

### *Conflict of Interests*

The authors declare that they have no conflict of interests.

### *Authors' Contributions*

Fondjo Teu'Mbou Sa'Deu contributed to the conception of the study, the methodology of the study, the acquisition, analysis and interpretation of data, the drafting and the revision of the manuscript and approved the final submitted version.

Zunon-Kipré Yvan Jacques-Olivier Toualy contributed to the methodology of the study, the analysis and interpretation of the data, the drafting of the manuscript.

Kakou Konan Médard contributed to the conception of the study and revised of the manuscript.

Veillon Francis provided the study site and the imaging devices, contributed to the methodology of the study, the acquisition of the data and the revision of the manuscript.

Nchufor Roland helped for the correction of english expression and revised the manuscript.

Motah Mathieu revised the manuscript.

All authors read and approved the final manuscript.

All authors agreed to be accountable for all aspects of the work and to ensure that issues related to the accuracy or integrity of any part of the work are properly investigated and resolved.

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