

# Dhulikhel Hospital Checklist Protocol for Temporal Bone Computed Tomography Scan Analysis: How We Do It?

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## ABSTRACT

The temporal bone is very complicated anatomical structure. Any disease process within this structure mandates thorough anatomical knowledge of the corresponding structure. The High resolution computed tomography (HRCT) temporal bone is the best way to look inside this complex bone. The importance of knowledge about how to read and look inside the CT scan temporal bone lead us develop the Dhulikhel Hospital Check list protocol. This protocol will help aspiring otologist and otolaryngologist to read and know details about the underlying structures.

## KEY WORDS

*High resolution computed tomography, Otologist, Temporal bone*

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## INTRODUCTION

The high resolution computed tomography of the temporal bone (HRCT temporal bone) is now mandatory for identifying the anatomy (both normal and abnormal), pathology of the temporal bone and performing the precise ear surgery. So it is considered as the important preoperative investigation before performing mastoid surgeries. The multiplanar reconstruction (Axial, coronal and sagittal view) helps surgeon to identify the anatomical and pathological overview of the temporal bone, thus it assists surgeon to plan the surgery.<sup>1-3</sup>

Since there is difficulty in identifying the different structures of temporal bone while reading the HRCT of temporal bone, so we developed our own Dhulikhel Hospital Checklist protocol for evaluation of Temporal bone CT scan prior surgery. (Table 1) We hope this protocol will help every otologist to read CT scan without any difficulty.

### Anatomical Landmarks to consider during reading the CT scan temporal bone

The protocol includes the checklist in an alphabetical order from A-F as shown in table 1.

First of all we have to look for the **Attic and scutum** (figure 1) of the temporal bone to see if any erosion or blunting because the cholesteatoma may involve these structures. In the mean time we have to look at the Prussak's space which is the main site for the genesis of cholesteatoma.

**Air cells of mastoid** (figure 2) is an another important landmark to look upon because the pneumatisation of the mastoid air cells tells us about the developmental status of the mastoid bone and difficulty during surgery. Likewise, the ventilation of the mastoid air cells helps us to know about the status of air filled mastoid cells.

**Table 1. Showing considerable things during reading of anatomical landmarks in HRCT temporal bone**

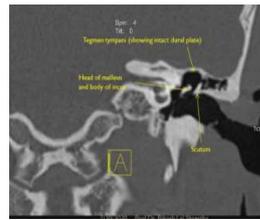
Checklists of Anatomical Land marks	Things to consider
<b>A</b>	<b>Attic and Scutum</b> Erosion/Blunting/ Status of Prusak's space
	<b>Air cells of Mastoid</b> Ventilation and Pneumatisation
	<b>Aqueduct (Vestibule and Cochlear)</b> Congenital anomaly
<b>B</b>	<b>Blood vessels</b>
	<b>Sigmoid sinus</b> Anterior lying/ Bony dehiscence
	<b>Jugular bulb</b> High riding/ Bony dehiscence
	<b>Carotid artery</b> Bony dehiscence/ aberrant stapedial artery
<b>C</b>	<b>Canals</b>
	<b>External auditory canal</b> Atresia/stenosis/bony dehiscence
	<b>Internal auditory canal</b> Congenital anomaly
	<b>Semicircular canals and Vestibule</b> Bony dehiscence
	<b>Chain ossicular</b> Erosion/Missing/Disarticulation
	<b>Cochlea</b> Congenital anomaly
	<b>Corners (Sinus tympani and Facial recess)</b> Depth/Opacification
<b>D</b>	<b>Dural plate/Tegmen</b> Low lying/Bony dehiscence
	<b>Drum (tympanic membrane)</b> Retraction/Perforation
<b>E</b>	<b>Eustachian tube</b> Patency/Obstruction
<b>F</b>	<b>Facial Nerve</b> Abnormality/bony dehiscence

**Aqueduct of Vestibule and cochlea** (figure 3 and 4) is an important structure to look for any congenital anomaly. This structure has an important clinical significance on congenital hearing loss and prior cochlear implantation surgery.

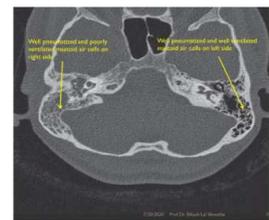
**Blood vessels-Sigmoid sinus** (figure 5) is an important blood vessels during mastoid surgery. We have to see if it is anteriorly lying or not, and the status of bone overlying the sinus. Because the anteriorly lying sinus may decrease the safety space while performing the antrostomy.

Another important blood vessel is the **jugular bulb** (figure 5). We have to see whether it is high riding or not. The high riding blood vessels with dehiscence overlying bone may lead to injury during tympanoplasty and ventilation tube insertion. This high riding vessels also compromise the hypotympanic view.

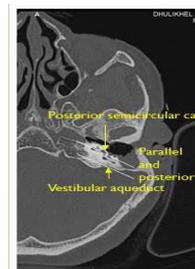
The **carotid artery canal** (figure 5) is the very important structure. It should be examined for any bony dehiscence or abnormal anatomical position. The aberrant carotid artery may lie more laterally than the normal position.



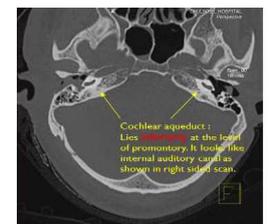
**Figure 1. Showing attic and scutum (axial section).**



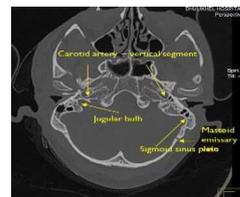
**Figure 2. Showing air cells of mastoid bone (axial section).**



**Figure 3. Showing vestibular aqueduct (axial section).**



**Figure 4. Showing cochlear aqueduct (axial section).**



**Figure 5. Showing blood vessels (sigmoid sinus, jugular bulb and carotid artery in axial section)**



**Figure 6. Showing external auditory canal (axial section).**



**Figure 7. Showing internal auditory canal (axial section).**

The condition of the **external auditory canal** (figure 6) is an important anatomical structure. We should look for any congenital atresia, stenosis or bony dehiscence. When a destruction is seen, one should think of the necrotising otitis externa or a malignant condition. In keratosis obturans, there will be an asymmetrical canal appearance consistent with canal expansion or ballooning without any bony destruction when compared to the contralateral normal side. Where as in external auditory canal cholesteatoma, there will be focal destruction of bone.

The **internal auditory canal** (figure 7) should be looked for any congenital anomaly or atresia.

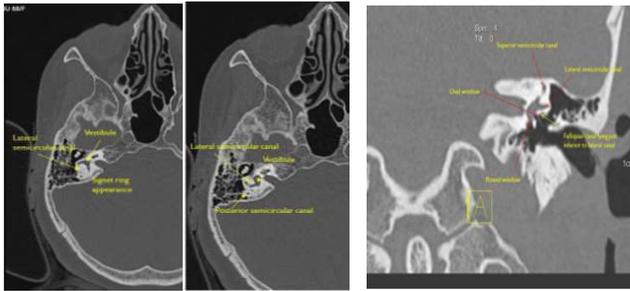


Figure 8. Showing lateral semicircular canal (axial section).

Figure 9. Showing lateral semicircular canal (coronal section)

The Lateral **semicircular canal** which looked like signet ring (figure 8 and 9) should be specifically observed for any fistula or dehiscence because cholesteatoma may erode the lateral canal. The superior canal should be looked for any bony dehiscence. The vestibule is another important structure to see for any congenital anomaly.

The **ossicular chain** looks like ice cream cone (figure 10) or molar tooth appearance. It should be observed for any disarticulation, erosion or its absence. The thickening of the stapes footplate, fissa ante fenestram should be observed in case of otosclerosis.



Figure 10. Showing ossicular chain (axial section).

Figure 11. Showing cochlea (axial section).

The **cochlea** (figure 11) looks like stacks of coin in CT scan. It is necessary to look for ossification or any anomaly.

The **corners** (figure 12) like **sinus tympani** is important to look for its depth and any opacity as there may be cholesteatoma in sinus tympani area. Likewise the **facial recess** should be looked for its pneumatization and depth as it is necessary during implantation surgery or combined approach tympanoplasty.

The position of **dura and tegmen plate** (figure 1) is important. The low lying dura may lead to dural injury during mastoid surgery. So it helps to take precaution if we know it beforehand. If dural or tegmen defect is there then we have to look for any herniation of brain or disease like cholesteatoma invading the plate.

The **drum (tympanic membrane)** (figure 13) is essential to look for retraction or perforation during CT scan reading.

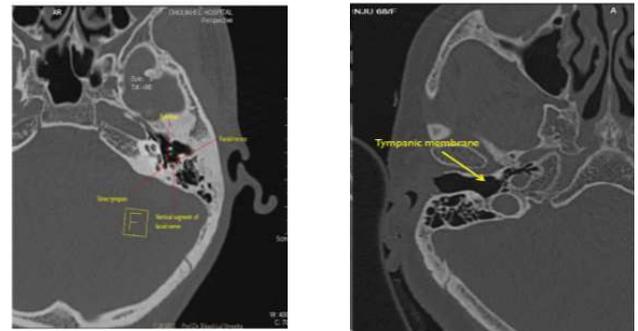


Figure 12. Showing corners (facial recess and sinus tympani in axial section).

Figure 13. Showing drum (tympanic membrane in axial section).

The **eustachian tube** (figure 14) should be looked for its patency or obstruction.

The **facial nerve** (figure 15 and 16) is a very important structure to identify and look carefully in CT scan because there may be dehiscence or anomaly of nerve which may lead unnecessary surgical complications.

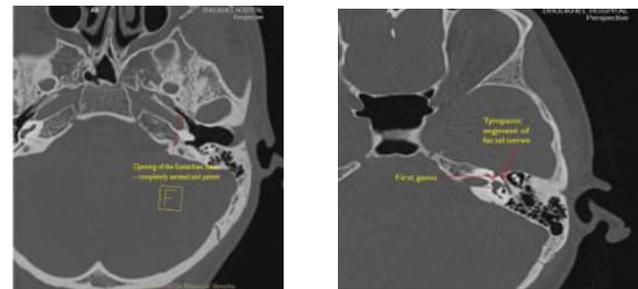


Figure 14. Showing eustachian tube (axial section).

Figure 15. Showing facial nerve (axial section).

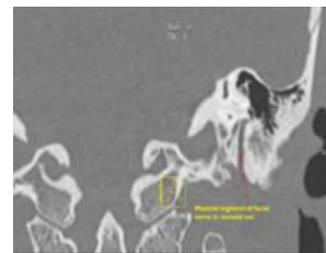


Figure 16. Showing facial nerve (coronal section).

Video link: <https://www.youtube.com/watch?v=ttyxhJdc1j4>

**CONCLUSION**

The checklist protocol of reading HRCT temporal bone is an essential tool to identify detail anatomical overview. However the ample amount of anatomical and pathological knowledge is necessary to plan and perform safe surgery. We hope our protocol will help trainee otolaryngology surgeons and otologist to systematically read CT temporal bone and plan surgery accordingly.

## REFERENCES

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