

Jeweler's Cut: An Innovative Technique for Middle Ear Dissection

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Abstract: *The temporal bone is a valuable piece of resource for the purpose of study of ear diseases and to teach its anatomy. Dissection of the middle ear is a complicated procedure. The most commonly used method is the Piece Meal Removal of the bone or chipping/snipping off the bone into pieces and the block method of harvesting human cadaveric temporal bones. Many of the medical professionals have ever seen the real ossicles in their life time. The methods adopted earlier were intricate and time consuming. The present study was conducted in the department of Anatomy, Assam Medical College, Dibrugarh, Assam in the year 2018 on 20 intact temporal bones of 10 base of skull. The jeweler's cut method a new innovative method was performed and we tried to evaluate the efficacy and reasonability of the technique. By this method the temporal bone can be exposed to see the middle ear cavity as like the pictures in the textbook of Anatomy. The jeweler's cut method proves to be the scientific, accurate and least destructive method of dissection as compared to the traditional methods of piece meal removal of bone as chipping away the roof (tegmen tympani) or snipping off done for exploring the middle ear cavity and mastoid air cells.*

Keywords: Middle ear cavity, Ossicles, Chisel, Jeweler's Cut, Temporal bone

1. Introduction

"I Hear and I Forget, I See and I Remember, I Do and I Understand"[1]. As technology becomes part of our everyday lives with the birth of digital technologies, schools are making attempts to utilize technology to help provide the best learning experience for students[2]. Many students experience discomfort with the use of cadavers in the dissecting room which has been considered to bring about a barrier to the teaching and of anatomy, this discomfort could arise from a number of factors including anxiety, the use of formalin, appearance irritation, how the dissecting room smells, or mostly the presence of the dead[3].

Traditionally, the methods used in learning anatomy are based on the use of textbooks, 2D diagrams and dissection sessions meanwhile the human body is three dimensional (3D). However, students who have low-spatial ability have difficulties in understanding the structures in 3D space and finding muscles, nerves, and organs during dissection. There is change in the way students chose to master a subject in this age of digitization [4].

The temporal bone is a valuable piece of resource for the purpose of study of ear diseases and to teach its anatomy. It is one of the most complicated bones of the skull. Methods of dissecting the middle ear have been described in the text books of Anatomy [5].

Anatomy by its very nature is three-dimensional (3D). dissection, cross section and surface anatomy are the traditional 3D methods used to teach and learn anatomy. When using two- dimensional (2D) representations such as 2D digital images, textbooks, or chalk and maker drawings, understanding complex relationships of human anatomy

requires an important amount of cognitive representation to fully understand anatomical structures and their functions [6].

Dissection of the middle ear is a complicated procedure, and only a few methods for dissecting the middle ear have been described in the textbooks of Anatomy [7].

The most commonly used method is the Piece Meal Removal of the bone or chipping/snipping off the bone into pieces. Specimens are rarely available for such difficult topics, even in the well established departments of various colleges, all over the world. Many of the medical professionals have ever seen the real ossicles in their life time. The methods adopted earlier were intricate and time consuming. Moreover, they also required sophisticated instruments like Electric Autopsy Saw Laurensen [8].

Intracranial complications of middle ear infections, in particular otogenic meningitis, are life-threatening diseases burdened with a high mortality rate[9].

2. Materials and Methods

The present study was conducted in the department of Anatomy, Assam Medical College, Dibrugarh, Assam in the year 2018 on 20 intact temporal bones of 10 base of skull after the completion of head and neck dissection by first year MBBS students. Due to non-availability of cadavers only 10 base of skulls were taken for the study. The base of skulls were collected first and cleared off all the soft decomposed tissues attached to the bone.

Numbering of the temporal bones was done before removal from the base of the skull from 1 to 10 for 10 base of skulls. For male skull 1 to 5 and for female skull from 6 to 10 and

sides were numbered as 1 right medial in the medial side and 1 right lateral in the lateral side of the right temporal bone & 1 left medial in the medial side and 1 left lateral in the lateral side of the left temporal bone etc. Ages were not known. Jeweler’s saw, climax fixed base table baby vice, both side tape, chisel, hammer, fine forceps, probe or needle, gloves, gauge pieces and marker pen were required for the jeweler’s cut.

Table 1: Numbering of the temporal bones

S no. of skull	Sex	Side			
		Right		Left	
		Medial	Lateral	Medial	Lateral
1	Male	1RM	1RL	1LM	1LL
2	Male	2RM	2RL	2LM	2LL
3	Male	3RM	3RL	3LM	3LL
4	Male	4RM	4RL	4LM	4LL
5	Male	5RM	5RL	5LM	5LL
6	Female	6RM	6RL	6LM	6LL
7	Female	7RM	7RL	7LM	7LL
8	Female	8RM	8RL	8LM	8LL
9	Female	9RM	9RL	9LM	9LL
10	Female	10RM	10RL	10LM	10LL

Numbering and marking of the packets and vials were done writing by marker pen on sticker and pasted over the packets and vials, finally the vials were kept within the same no packets as follows: 1R, 1L, 2R, 2L, 3R, 3L, 4R, 4L, 5R, 5L, 6R, 6L, 7R, 7L, 8R, 8L, 9R, 9L, 10R and 10L.

Steps of Dissection

Removal of temporal bone from skull-

The temporal bones were removed from the skull with the help of the Chisel & Hammer manually. Steps taken for the removal of the intact temporal bone from the base of skull was adopted as following the cobbler’s cut [10].

- 1) The zygomatico-temporal suture was cut open firstly by Chisel & Hammer (Figure2).
- 2) Then Chisel was penetrated through the parieto-temporal suture and pushed on the lateral side making the temporal bone relieved from the skull with its all parts (Figure 2).



Figure1: Materials used for Jeweler’s cut (Jeweler’s Saw, Climax Fixed Base Table Baby Vice, Both Side Tape, Chisel, Hammer, Fine Forceps and Probe or Needle, Gloves, Gauge pieces and Marker pen)

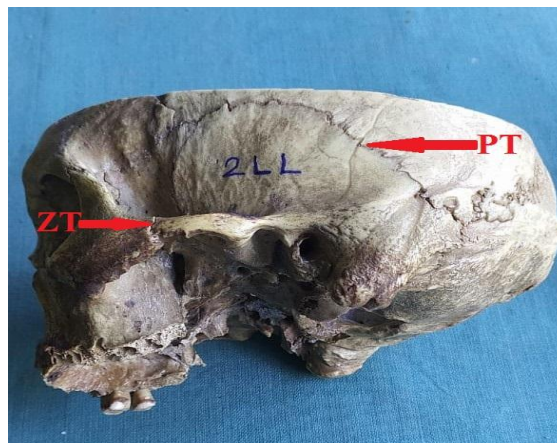


Figure2: Lateral surface of the skull (PT=Parietotemporal suture, ZT=Zygomatico-temporal suture.)

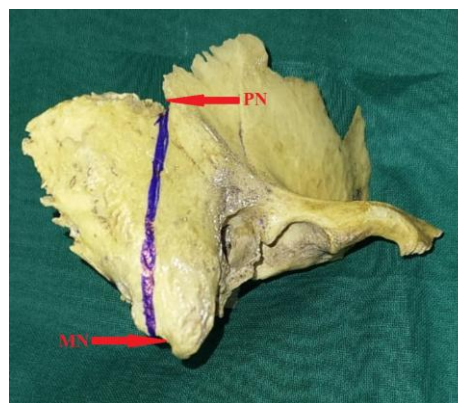


Figure 3: Lateral surface of the right side temporal bone where the blue line denotes ‘the circular line’ by marking pen (PN=Parietal Notch, MN=Mastoid notch.)

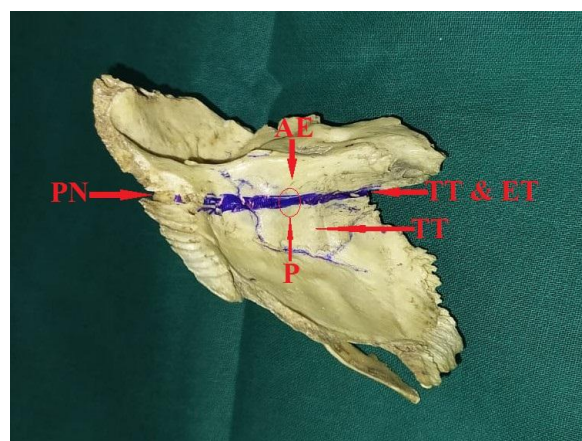


Figure 4: Anterior surface of petrous part of the right side temporal bone where the blue line denotes ‘the circular line’ by marking pen (PN=Parietal Notch, AE=Arcuate eminence, TT= Tegmen tympani, P=Point between AE and TT, TT & ET=Opening of canal for tensor tympani muscle and eustachian tube.)

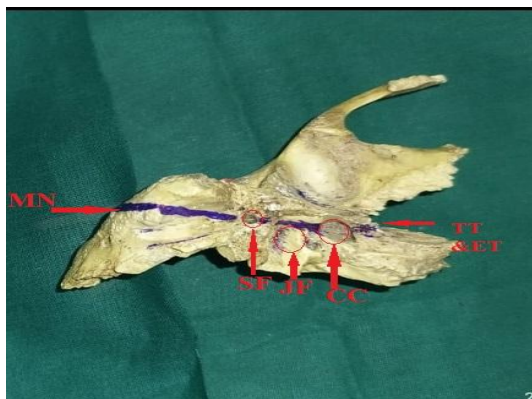


Figure 5: Inferior surface of petrous part of the right side temporal bone where the blue line denotes 'the circular line' by marking pen (MN=Mastoid notch, SF=Stylomastoid foramen, JF= Jugular fossa, CC= Lower opening of carotid canal, TT & ET=Opening of canal for tensor tympani muscle and eustachian tube.)

Jeweler's Cut of the temporal bone

- 1) Over the temporal bone a circular marking was done by a marker pen through the following points: i. Above the canal for tensor tympani muscle and eustachian tube, ii. In between the arcuate eminence and tegmen tympani, iii. Parietal notch, iv. Mastoid notch, v. Stylomastoid foramen, vi. Lateral border of jugular fossa, vii. Lower opening of carotid canal.
- 2) The temporal bones were covered by both side tape on its medial side (covering internal acoustic meatus) and lateral side (covering external acoustic meatus) so that the bone can be hold by the vice.
- 3) The bone was placed between the two jaws of the vice to be hold tightly to hold the temporal bone in anatomical position.
- 4) The bone was cut with jeweler's saw in vertical plane slowly so that the force applied can be tolerated by bone holding procedure (a) first along the marking line drawn in the anterior surface of the petrous part till the roof (tegmen tympani) of the middle ear, then (b) place the bone upside down and cut along the line drawn in the inferior surface of petrous part till the floor of middle ear, (c) again placing the bone keeping its anterior end (Apex) upside and cut along the marked till anterior wall of middle ear, (d) finally again placing the bone keeping anterior end downside and cut the bone along the marked line till the posterior wall of middle ear without any damage of the ossicles.
- 5) Thus temporal bones were easily divided into two parts, the medial part (Figure 6.B & Figure 7.B) and the lateral part (Figure 6.A & Figure 7.A).
- 6) The ossicles were picked up from exposed bones by fine forceps and preserved in the respective vials.
- 7) The both side tape attached in the bones were cleaned and again the markings were checked and marked in erased parts.
- 8) The pair of sections from each temporal bone were preserved in the 20 polythine packets (4x4 inch) along with its ossicles in 20 separate small vials whatever found after dissection.
- 9) Finally all polythine packets were kept in a box for the purpose of further study and teaching.

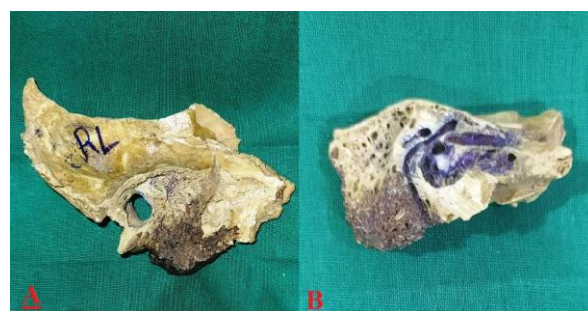


Figure 6: Right side temporal bone after division (A=Right lateral part, B=Right medial part)



Figure 7: Left side temporal bone after division (A=Left lateral part, B=Left medial part)

3. Results & Observations

The jeweler's cut method was performed in 20 temporal bones collected from both sides of 10 base of skulls to evaluate the efficacy and reasonability of the technique. By this method the temporal bone can be exposed to see the middle ear cavity looking all the features mentioned in the text books of anatomy. The ear ossicles (Malleus, Incus & Stapes) were collected & preserved (Figure 8). The complete sets of the ossicles were not found. So, only 6 Malleus, 6 Incus and 4 Stapes were retrieved out from these 20 temporal bones. The missing of tympanic membranes and ossicles in the middle ear cavity might be due to consequences of decay or infestation of fauna and flora on these decomposed skulls.

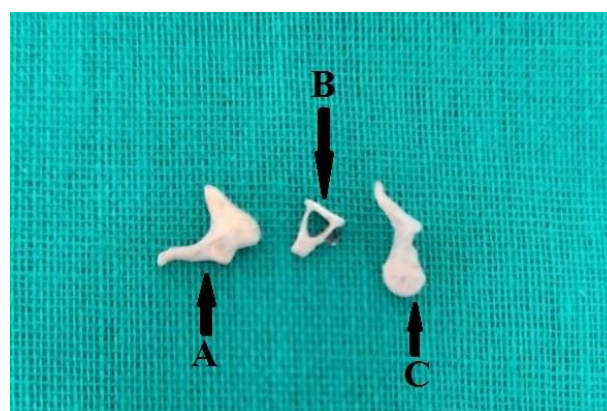


Figure 8: Ear ossicles (A= Incus, B= Stapes, C= Malleus)

Most interestingly we could get the view of features in the medial half of the sections as shown in the figure no: 154 of Cunningham's Manual of Practical Anatomy[11].

Table 2: Showing the findings of ear ossicles

Number & Side of temporal bone	Ossicles		
	Stapes	Incus	Malleus
1R	✓	✓	✓
1L		✓	✓
2R		✓	✓
2L		✓	✓
3R			
3L			
4R	✓		
4L			
5R			
5L			
6R			
6L			
7R	✓		
7L			
8R			
8L			
9R			
9L			
10R		✓	✓
10L	✓	✓	✓
Total=16	4	6	6

4. Discussion and Conclusion

Human temporal bones provide an irreplaceable resource for study of the pathology and patho-physiology of disorders of hearing, balance, taste and facial nerve function [12]. Temporal bone anatomy has traditionally been taught using cadaveric specimens [13] and the block method (BM) of harvesting human cadaveric temporal bones for otolaryngology resident education and training [14]. However, endoscopic cadaveric dissection of the middle ear allows a very good visualization of the epitympanic diaphragm, Prussak's space and middle ear anatomy in general, that until now, have been performed using a microscope[15].

Those methods were more time consuming and less productive, hence less advantageous. Moreover, the view of the internal structures and anatomical features of the middle ear cavity by this technique are more apparent needs no further elaborations. Moreover, the ossicles so received can be used for potential further study for forensic aspects[16]. The '*jeweler's Cut*' method proves to be the scientific, accurate and least destructive method of dissection as compared to the traditional methods of piece meal removal of bone as chipping away the roof (tegmen tympani) or snipping off done for exploring the middle ear cavity and mastoid air cells [17],[18].

The term '*jeweler's Cut*' was used here on the basis of observations made during the authors visit to a jeweler's shop for repairing of finger ring who was using his hand saw instrument with wooden handle for cutting and finishing the ornaments. So, the same method was applied on the temporal bone to cut it to see the different features like Facial canal, Groove for geniculate ganglion, lateral semicircular canal, Auditory canal, Canal for tensor tympani muscle, Promontory, Oval window, Round window, mastoid air

cells, mastoid antrum, thickness of tegmen tympani, aditus, pyramid and the ossicles. Before that we tried to use hand saw instrument that commonly used by carpenter to cut wooden materials, but we found it was not suitable to cut temporal bone to expose the minute features in the wall of middle ear cavity because of its thickness can destroy the wall.

Usually it is seen that the base of the skull are not preserved after dissection, due to lack of instruments and technically trained persons to examine the temporal bones. There is no system to record the name, age, sex, cause of death of the cadavers after dissection in the anatomy departments so far. So this kind of study will inspire the future researcher regarding the causes of ear diseases and it would be found easy and practical for the purpose of temporal bone cutting. During teaching for undergraduate students in the dissection hall, we anatomist have observed that by the time for dissection of the ear is scheduled the skull is almost completely disintegrated and is hardly of any use for the specific study of middle ear including ossicles[10]. So, this method can be used as a routine procedure for the learning of complete temporal bone anatomy that will add in the enhancing of knowledge of not only undergraduate or post graduate students in general but also the nascent ENT surgeons in particular who are always have a paucity of such specimens.

References

- [1] Regis Vaillancourt "I Hear and I Forget, I See and I Remember, I Do and I Understand", CJHP – Vol. 62, No. 4 – July–August 2009 pp-272.[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2826962/]
- [2] Agostini A, Di Biase E, Loregian M. "Stimulating cooperative and participative learning to match digital natives' needs." In2010 8th IEEE International Conference on Pervasive Computing and Communications Workshops (PERCOM Workshops) pp. 274-279, Mar 29, 2010.
- [3] Jeng, Y. L., Wu, T. T., Huang, Y. M., Tan, Q., & Yang, S. J. "The add-on impact of mobile applications in learning strategies: A review study". Journal of EducationalTechnology & Society.13(3):3-11. AIF:0,41. 2010.
- [4] Fredieu, J. R., Kerbo, J., Herron, M., Klatt, R., & Cooke, M. "Anatomical models: a digital revolution. Medical science educator". 25(2):183-194. 2015.
- [5] Romanes GJ. "The Organs of Hearing and Equilibration: Cunningham's Manual of Practical Anatomy" vol. 3 (15th edn), Oxford Medical Publications, New York, USA 171-182, 1986.
- [6] Garg AX, Norman G, Sperotable L. "How medical students learn spatial anatomy". Lancet. 357:363–364, 2001.
- [7] White TD, Black MT, Folkens PA. "Human Osteology". 3rd ed. Elsevier Academic Press, pp 70-71, 2012.
- [8] Laursen RD. "A rapid Method Of Dissecting The Middle Ear". Anat Rec 151: 503-505, 1965.

- [9] Luca Bruschini et al “Otogenic Meningitis: A Comparison of Diagnostic Performance of Surgery and Radiology” on behalf of GISA (Italian Group for Antimicrobial Stewardship) Meningitis Study Group [Online] Available: <https://academic.oup.com/ofid/article-abstract/4/2/ofx069/3110219> by guest on 10 December 2017.
- [10] Singh K, Sirohiwal BS, Rohilla A, Chhabra S and Gupta G: “Cobbler’s Cut: An Innovative Technique for Middle Ear Dissection”, J Forensic Res ;Vol-5, Issue-2, 2014.
- [11] Romanes GJ. “The Organs of Hearing and Equilibration: Cunningham’s Manual of Practical Anatomy”, vol. 3 (15th edn), Oxford Medical Publications, New York, USA 175, 1986.
- [12] Nadol JB Jr .“Techniques for human temporal bone removal: information for the scientific community”. Otolaryngol Head Neck Surg 115: 298-305, 1996.
- [13] George AP, De R .“Review of temporal bone dissection teaching: how it was, is and will be”. J Laryngol Otol 124: 119-125, 2010.
- [14] Walvekar RR, Harless LD, Loehn BC, William Swartz. “Block method of human temporal bone removal: a technical modification to permit rapid removal”. Laryngoscope 120: 1998-2001, 2010.
- [15] Marchioni D, Alicandri-Ciufelli M, Grammatica A, Mattioli F, Genovese E, et al. “Lateral endoscopic approach to epitympanic diaphragm and Prussak’s space: a dissection study”. Surg Radiol Anat 32: 843-852, 2010.
- [16] Singh K, Chhabra S, Lal Sirohiwal B, Yadav SPS “Morphometry of Malleus a Possible Tool in Sex Determination”. J Forensic Res 3: 6, 2012.
- [17] Warthin AS. “Practical Pathology: A Manual of Autopsy and Laboratory Technique”. (2ndedn), George Wahr Publisher, Ann Arbor 81-85, 1911.
- [18] Cattell HW . “Postmortem Pathology: A Manual of the Technic of Post-Mortem Examination and the Interpretations”. (3rdedn), JB Lippincott Company, Philadelphia and London 272-274, 1906.



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