# Application Effect of Reading List in Teaching of Temporal CT Reading

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# Abstract

Background Temporal CT is the most commonly used imaging data in the clinical work of otology. How to cultivate and improve the ability of residents to read images has become an important focus in clinical teaching. Our aim is to explore the application effect of reading list in the reading teaching of temporal CT for resident otologists. Methods The resident otologists were selected as subjects and randomly divided into a Group A and a Group B. Group A adopted reading list of temporal CT while Group B did not adopted reading list. The ability of student to read temporal CT was tested and evaluated. Results The scores and identification proficiency of temporal CT in Group A were significantly better than those in Group B after training. The evaluation in the learning interest, prediction ability of surgical risk, prevention of missed diagnosis and misdiagnosis risk, doctor-patient communication ability, standard organization of reading, self-confidence in reading, self-learning of reading, and satisfaction degree with reading teaching methods in Group A were better than those in Group B. Conclusion Application of reading list can improve the ability of resident otologists to read temporal CT and predict surgical risk, and help students cultivate the standard reading habits and enhance their interest in learning.


# Introduction

Temporal imaging data is very important in the clinical diagnosis and treatment of otology. High-resolution thin-layer CT/MRI of temporal bone has a high diagnostic positive rate for otological diseases, and what's more, it provides guidance for otological surgery, including determining surgical scope, selecting surgical approach, designing surgical incisions and predicting surgical complications, etc. Therefore, otological surgeons must have good reading ability of temporal images, and how to cultivate and improve the ability of residents to read images has become an important focus in clinical teaching.

Previous studies mainly focused on the role and significance of temporal images in middle and inner ear surgery[1, 2], but how to conduct teaching of temporal images for otologists and improve their ability to read images from the focus and perspective of otological surgeons has not been reported in literature. Although there were some commonalities in reading teaching between otology and other specialties such as imaging and orthopedics[3–5], it is necessary to explore the teaching methods suitable for the characteristics of otological surgery due to the different teaching procedures and characteristics of each specialty.

Temporal CT is the most commonly used imaging data in clinical work of otology. During this study, we conducted reading teaching of temporal CT by using the method of reading list to explore the application effect of this method.

# Methods

### Subjects

Students who participated in the standardized training of residents in the ENT Department at the First Affiliated Hospital, Sun Yat-sen University, from January 2018 to December 2019 were selected as subjects and randomly divided into an experimental group (Group A) and a control group (Group B). All students had been informed the contents of this study and had signed informed consent form.

## Implementation of teaching

Group A adopted mixed teaching as the reading teaching mode: the reading list was not used in the initial stage of training, and the reading teaching was carried out with reference to CT reports of the Imaging Department; the reading list was used in the middle stage of training, and the reading of temporal CT was completed according to the contents of list. Group B did not adopt reading list in reading teaching: the reading teaching was carried out with reference to CT reports of the Imaging Department throughout the training. Combined with the relevant literature and the actual situation of otological teaching[6, 7], this study drew up a reading list of preoperative temporal CT for common otological diseases based on the principle of simplicity, comprehensiveness and easy operation (Table 1). After reading, students analyzed the precautions and risks of surgeries and formulated the surgical plans.

**Table 1.** Reading list of temporal CT

| Reading Type | Observation Focus | Surgical Risk and Accident Evaluation |
|---|---|---|
| Patient Data | Consistent Name | --- |
| CT scanning parameters and anatomical variations of middle and inner ear in coronary and transverse position | Identification of bone window and soft tissue window; scanning range | --- |
| Middle cranial fossa | Drooping | Cerebrospinal fluid otorrhea |
| Sigmoid sinus wall | Advanced or superficial | Bleeding |
| Bulb of jugular vein | High position, bone deficiency | Bleeding |
| Scope of Lesion | | |
| Scope of soft tissue shadow | Mastoid process, tympanic antrum, middle and upper tympanum | Scope of Surgery |
| Degree of temporal gasification | | Difficulty and duration of surgery |
| Ossicular chain structure | Gasification, diploe, sclerosis, mixed | |
| Facial nerve bone canal | Integrity of malleus, incus, and stapes; incudomalleolar joint and incudostapedial joint | Hearing loss |
| | Integrity of vertical segment, tympanic segment and labyrinth segment; bone destruction | Facial nerve injury |
| Cochlea, vestibule, semicircular canal | Deformity and bone destruction | Sensorineural deafness |
| Other important structural conditions | Damage of meninges and carotid arteries | Cerebrospinal fluid otorrhea, bleeding |

## Methods of evaluation

Self-evaluation of identification proficiency of middle ear structure CT: before and at the end of the training, Visual Analogue Scale (VAS) was used to evaluate the identification proficiency of middle and inner ear structure CT of students in two groups. Each item ranged 0 - 10 points: 0 point as completely unskilled, 1 - 3 points as unskilled, 4 - 6 points as generally skilled, 7 - 9 points as skilled, and 10 points as extremely skilled.

Temporal CT reading test: in the initial and middle stage and at the end of the training, the reading test of temporal CT was conducted in students. The total score was 100 points, and the test contents included the identification of middle and inner ear structure CT, the analysis of middle and inner ear lesions, and the characteristics of CT for common otological diseases, etc.

Questionnaire: at the end of the training, students in two groups were investigated by anonymous questionnaire to understand the implementation effect of the two teaching modes. The evaluation items of the questionnaire included learning interest, prediction ability of surgical risk, prevention of missed diagnosis and misdiagnosis risk, doctor-patient communication ability, standard organization of reading, self-confidence in reading, self-learning of reading, and degree of satisfaction with teaching method of reading. The evaluation results were divided into dissatisfied, neutral, and satisfied.

### Statistical analysis

SPSS 22.0 software was used in this study for statistics. The measurement data were expressed as $\bar{x} \pm s$ and tested by t test for inter-group and intra-group comparisons. The enumeration data were expressed as number of cases and percentage and tested by Fisher or $\chi^2$ test, the ranked data were tested by nonparametric rank sum test (Kruskal-Wallis Test), and the difference was statistically significant if $P < 0.05$.

## Results

### General data of subjects

There were 34 residents in Group A, including 19 males and 15 females with an average age of 26.4 ± 1.6 years; there were 30 residents in Group B, including 18 males and 12 females with an average age of 25.8 ± 1.5 years. There was no significant difference between the two groups in terms of sex, age, education, pre-training otological work time and scores of basic theory (Table 2). Each otological training period was 6 months, and the middle stage of training was 3 months. Senior attending otologists and deputy chief otologists served as teachers.

Table 2. Characteristics of subjects in Groups A and B

| Item | Group A (n=34) | Group B (n=30) | *t* value | *P* value |
|---|---|---|---|---|
| Gender | | | | |
| Male | 19(55.9%) | 18(60.0%) | 0.11 | 0.73* |
| Female | 15(44.1%) | 12(40.0%) | | |
| Age (Yrs.) | 26.4±1.6 | 25.8±1.5 | 1.54 | 0.13 |
| Education | | | | |
| Undergraduate | 11(32.4%) | 10(33.3%) | Fisher | 0.95** |
| Postgraduate | 20(58.8%) | 18(60.0%) | | |
| Doctor | 3(8.8%) | 2(6.7%) | | |
| Pre-training otological working time (practitioners) | | | | |
| 0 year | | | | |
| 0–1 year | 26(76.5%) | 23(76.7%) | Fisher | 0.99** |
| >1 year | 6(17.6%) | 5(16.7%) | | |
| Pre-training scores of basic theory of otology (points) | 2(5.9%) | 2(6.7%) | | |
| | 65.4±5.2 | 64.8±6.5 | 0.41 | 0.68 |

Note: * using $\chi^2$ test; ** using Fisher test.

## Scores of identification proficiency of middle and inner ear structure CT

After an otological training period, the identification proficiency of the two groups for the middle and inner ear structure in temporal CT was greatly improved. Notably, there was no significant difference in the proficiency scores between the two groups before training (P > 0.05), but there was a significant difference in the proficiency scores between the two groups after training, of which the identification proficiency for each structure of middle and inner ear in CT in Group A was better than that in Group B (P < 0.05), indicating that the mixed teaching with reading list could help students improve their ability to identify the anatomical structure in temporal CT (Table 3).

**Table 3. Identification proficiency of middle and inner ear structure CT before and after training** - VAS scores (points, $\bar{x}$ ±□ )

| Proficiency Type | Group A (n=34) | Group B (n=30) | *P* value |
|---|---|---|---|
| Temporal CT reading | | | |
| Before training | 3.8±0.6 | 3.6±0.6 | 0.19 |
| After training | 7.5±0.5 | 6.2±0.7 | <0.01 |
| Overall middle and inner ear structure | | | |
| Before training | 3.4±0.5 | 3.6±0.4 | 0.08 |
| After training | 7.9±0.6 | 6.4±0.6 | <0.01 |
| Ossicle structure | | | |
| Before training | 4.1±0.5 | 3.9±0.6 | 0.15 |
| After training | 8.6±0.5 | 7.1±0.4 | <0.01 |
| Vestibular window and round window | | | |
| Before training | 2.7±0.6 | 2.5±0.5 | 0.16 |
| After training | 8.1±0.5 | 7.1±0.6 | <0.01 |
| Facial nerve and bone canal | | | |
| Before training | 3.1±0.6 | 3.3±0.4 | 0.13 |
| After training | 6.8±0.7 | 5.5±0.6 | <0.01 |
| Hypotympanum, tympanic opening of auditory tube | | | |
| Before training | | | |
| After training | 4.3±0.5 | 4.4±0.6 | 0.47 |
| Scute, tympanic sinus, facial nerve recess | 8.7±0.5 | 7.8±0.6 | <0.01 |
| Before training | | | |
| After training | 4.5±0.5 | 4.3±0.6 | 0.15 |
| Cochlea, vestibule, semicircular canal | 7.8±0.4 | 5.6±0.6 | <0.01 |
| Before training | | | |
| After training | 2.2±0.6 | 2.3±0.5 | 0.48 |
| Sigmoid sinus, bulb of jugular vein, carotid canal | 6.4±0.5 | 5.1±0.4 | <0.01 |
| Before training | | | |
| After training | 3.1±0.5 | 2.9±0.5 | 0.12 |
| Middle cranial fossa, posterior cranial fossa, vestibular aqueduct | 6.8±0.6 | 5.3±0.4 | <0.01 |
| Before training | | | |
| After training | | | |
| | 2.6±0.5 | 2.7±0.4 | 0.38 |
| | 7.3±0.4 | 5.8±0.5 | <0.01 |

## Scores of temporal CT reading test

The scores of reading in the two groups showed escalation trend in the initial and middle stage and at the end of the training (P < 0.01), indicating that both teaching modes could promote the students' identification of temporal CT. However, it is worth noting that there was no significant difference in the scores of temporal CT reading test between the two groups in the early and middle stages of the training; at the end of the training, there was a difference between the two groups: the scores (84.2 ± 7.1 points) of Group A were significantly better than those (76.2 ± 6.4 point) of Group B (t = 4.71, P < 0.01). The results further demonstrated that the scores of Group A were better than those of Group B due to the application of teaching mode with reading list after the middle stage of the training (Tables 4 - 6).

**Table 4. Scores of CT reading test in two groups during training (point, $\bar{x} \pm s$)**

| Group | Cases | Initial Stage | Middle Stage | Completion |
|---|---|---|---|---|
| GROUP A | 34 | 55.4±5.3 | 71.4±6.2 | 84.2±7.1 |
| GROUP B | 30 | 56.2±6.5 | 72.3±5.5 | 76.2±6.4 |
| *t* value | --- | -0.54 | -0.61 | 4.71 |
| *P* value | --- | 0.59 | 0.54 | <0.01 |

**Table 5. Comparison of scores of CT reading test in Group A during training (point, $\bar{x} \pm s$ )**

| | earlier stage | | middle stage | | at the end of stage | |
|---|---|---|---|---|---|---|
| | t | P | t | P | t | P |
| earlier stage | | | -11.44 | <0.01 | -18.95 | <0.01 |
| middle stage | 11.44 | <0.01 | | | -7.92 | <0.01 |
| at the end of stage | 18.95 | <0.01 | 7.92 | <0.01 | | |

**Table 6. Comparison of scores of CT reading test in Group B during training (point, $\bar{x} \pm s$ )**

| | earlier stage | | middle stage | | at the end of stage | |
|---|---|---|---|---|---|---|
| | t | P | t | P | t | P |
| earlier stage | | | -11.44 | <0.01 | -18.95 | <0.01 |
| middle stage | 11.44 | <0.01 | | | -7.92 | <0.01 |
| at the end of stage | 18.95 | <0.01 | 7.92 | <0.01 | | |

Results of questionnaire

In this study, a total of 64 questionnaires were sent out, a total of 64 effective questionnaires were recovered, and the recovery rate of effective questionnaires was 100%. The results of questionnaires showed that the evaluation in the learning interest, prediction ability of surgical risk, prevention of missed diagnosis and misdiagnosis risk, doctor-patient communication ability, standard organization of reading, self-confidence in reading, self-learning of reading, and satisfaction degree with reading teaching methods in Group A were better than those in Group B ($P < 0.05$), indicating that the use of reading list achieved good teaching effect (Table 7).

Table 7 Evaluation of two teaching modes of temporal CT reading by students

| Evaluation Item | GROUP A (n=34) | GROUP B (n=30) | Chi-square value | *P*value |
|---|---|---|---|---|
| Question 1 Beneficial to increasing interest in learning | | | | |
| 1 | | | | |
| 2 | 3(8.8%) | 7(23.3%) | 7.03 | <0.01 |
| 3 | 5(14.7%) | 10(33.3%) | | |
| Question 2. Beneficial to improving prediction ability of surgical risk | 26(76.5%) | 13(43.3%) | | |
| 1 | | | | |
| 2 | 1(2.9%) | 4 (13.3%) | 6.40 | 0.01 |
| 3 | 5(14.7%) | 10(33.3%) | | |
| Question 3 Beneficial to avoiding missed diagnosis and misdiagnosis | 28(82.4%) | 16(53.3%) | | |
| 1 | | | | |
| 2 | 1(2.9%) | 7(23.3%) | 7.40 | <0.01 |
| 3 | 8(23.5%) | 10(33.3%) | | |
| Question 4. Beneficial to improving doctor-patient communication skills | 25(73.5%) | 13(43.3%) | | |
| 1 | | | | |
| 2 | 4(11.8%) | 7(23.3%) | 4.61 | 0.03 |
| 3 | 7(20.6%) | 11(36.7%) | | |
| Question 5 Beneficial to improving standard organization of CT reading | 23(67.6%) | 12(40.0%) | | |
| 1 | | | | |
| 2 | 0(0%) | 5(16.7%) | 7.28 | 0.01 |
| 3 | 7(20.6%) | 10(33.3%) | | |
| Question 6 Beneficial to improving self-confidence in CT reading | 27(79.4%) | 15(50.0%) | | |
| 1 | | | | |
| 2 | | | | |
| 3 | 2(5.9%) | 7(23.3%) | 9.04 | <0.01 |
| Question 7 Beneficial to self-learning of CT reading | 6(17.6%) | 11(36.7%) | | |
| 1 | 26(76.5%) | 12(40.0%) | | |
| 2 | | | | |
| 3 | | | | |
| Question 8 Satisfaction with teaching mode | 3(8.8%) | 7(23.3%) | 5.38 | 0.02 |
| 1 | 9(26.5%) | 12(40.0%) | | |
| 2 | 22(64.7%) | 11(36.7%) | | |
| 3 | | | | |
| | 0(0%) | 6(20.0%) | 7.68 | <0.01 |
| | 4(11.8%) | 6(20.0%) | | |
| | 30(88.2%) | 18(60.0%) | | |

# Discussion

Common otological diseases, such as chronic suppurative otitis media and cholesteatoma of middle ear, need surgical treatment after definite diagnosis and temporal CT examination before surgery. Temporal

CT could clearly show whether the mastoid process, tympanic sinus, and tympanum have lesions involving middle cranial fossa, sigmoid sinus, bulb of jugular vein, facial nerve and other anatomical variations[8, 9], providing important preoperative reference for otologists and guiding surgical operations. However, the teaching of temporal CT reading from the perspective and focus of otological surgeons has not been reported in the field of clinical teaching. Our previous surveys found that, during the otological training period, teachers were not organized and systematic in the teaching of temporal CT reading, and did not have suitable reference contents or forms; students had low interest in learning and insufficient self-confidence in reading, and were prone to missed diagnosis and misdiagnosis, seriously affecting preoperative evaluation and intraoperative judgment. As a result, it is necessary to strengthen the teaching of temporal CT reading in the clinical otological teaching.

Simplicity of complex processes in clinical medical work in the form of lists was an emerging practice in recent years [10]. The use of lists helped physicians at all levels reduce errors in diagnosis and treatment, especially for inexperienced junior physicians [11, 12]. It was reported that good results were achieved by using the diagnostic list of chest X-ray in imaging students for reading teaching[6]. The reading list of temporal CT used in this study was made with reference to the relevant literature and the actual situation of otological teaching from the perspective of otologists. The contents included the common abnormalities of anatomical sites of middle and inner ear, the range of lesions and the precautions, which were not found in the previous literature. By using the reading list of temporal CT, students could systemically learn reading and check the missing and errors, so as to reduce the rates of missed diagnosis and misdiagnosis and stimulate their interest in learning. In addition, the repeated application of reading list could also help students remember the contents of list and cultivate the standard reading habits of temporal CT. We found that the results of reading in Group A using reading list of temporal CT were significantly better than those in Group B, the reading efficiency, organization and self-confidence of students in Group A were significantly improved, and the satisfaction with the teaching mode of reading list in Group A reached 88.2%.

For common otological diseases, the focus of preoperative reading of CT is the anatomical variation of middle and inner ear and the range of lesions, which determines the surgical difficulty and the potential complications. When using reading list of temporal CT during teaching, according to the anatomical variations of middle and inner ear and intratemporal lesions, the complexity and complications of surgery can be predicted. Residents can have a clear gasp of situation when communicating with patients and their families before surgery, which is beneficial to improve the doctor-patient communication ability. The results of our questionnaire showed that the use of reading list of temporal CT improved residents' ability to predict surgical risk and their doctor-patient communication capability.

# Conclusion

To sum up, in the teaching of temporal CT reading, the application of reading list can help residents cultivate standard and systematic reading habits, enhance their interest in learning and their ability to read temporal CT. Because of small sample size in this study, teaching practice can be carried out in

multiple clinical centers in the future to expand the sample size. In addition, the contents of reading list of our temporal CT needs to be further improved, so as to promote its application in clinical teaching.

# Abbreviations

CT
computer tomography ;
MRI
magnetic resonance imaging ;
VAS
visual Analogue Scale ;

# Declarations

Ethics approval and consent to participate

This study was approved by the Sun Yat-sen University Ethics Committee for Research and Publication.

### Consent for publication

Not applicable.

### Availability of data and materials

All data are available upon request from the authors.

### Competing interests

The authors declare that they have no competing interests.


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### Authors' contributions

All of the authors were involved in the conception and design of the study, the analysis and interpretation of data, and the revision of the manuscript and have approved the final manuscript.

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