A Novel Interactive 3-Dimensional Model for Teaching and Learning the Anatomy of the Epitympanum

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ABSTRACT

Background and Purpose: The epitympanum is a challenging area for teachers and learners of its anatomy. Its complex 3-dimensional relations are difficult to appreciate using texts or 2-dimensional diagrams. We developed an interactive 3-dimensional computer-based model that can be viewed from all angles for teaching and learning.

Participants and Methods: The Model was evaluated by 21 fourth-year medical students in 2013. Students were given textbook and journal articles and 2-dimensional diagrams of the epitympanum to study, followed by a demonstration of the spatial relations using the Model in one session. A questionnaire was used to assess the utility of the Model.

Results:
- 81% of students found the anatomy difficult-to-understand.
- 14.3% found the texts easy-to-understand.
- 93.3% found the texts easy to understand with 2-dimensional diagrams.
- 90.5% agreed that the Model helps understanding the anatomy (p=0.07).
- 100% agreed that the Model helps in understanding and remembering the anatomy (38.1% strongly agreed).
- 100% agreed that the Model made understanding spatial relations easier than 2-dimensional diagrams (33.3% strongly agreed).
- 90.5% agreed that the Model helps in understanding the texts provided (28.6% strongly agreed).
- 100% agreed that the Model is useful to residents/students (38.1% strongly agreed).
- 100% agreed that the Model will be useful to teachers (47.6% strongly agreed).
- 100% agreed that they want this resource available if they were ENT residents (38.1% strongly agreed).

Conclusions: The 3-dimensional model is a useful tool in demonstrating the anatomy of the epitympanum. It can complement textbooks and 2-dimensional diagrams to facilitate understanding and recall.

INTRODUCTION

- The 3-dimensional (3-D) relations of the epitympanum are difficult to appreciate using texts or 2-dimensional (2-D) diagrams and often frustrates teachers and learners.
- Recently, the complex 3-D spaces in the paranasal sinuses have been creatively represented as geometrical blocks¹.
- We developed a 3-D computer-based model to demonstrate the anatomy of the epitympanum for teachers and learners in a step-by-step learner’s perspective.
- We analyzed the epitympanic spaces on CT scans and reviewed historical and contemporary descriptions²⁶ on this area.

Figure 1. Step 1: Ossicular chain and Tympanic Membrane.

Figure 2. Step 2: Addition of Ligaments, Mucosal Folds, and Bony Ceiling.

Figure 3. Step 3: Addition of spaces of the epitympanum.

Figure 4. Step 4: Addition of arrows depicting routes of cholesteatoma spread.

Figure 5.

METHODS

- The Model was evaluated by 21 fourth-year medical students in 2013. In a single session, they were given relevant textbook and journal articles and 2-D diagrams of the epitympanum to study, followed by a demonstration using the Model.
- Teaching of the anatomy of the 3-D Model was carried out in the following steps:
  1. The 1st frame – Structures of the middle ear were demonstrated.
  2. The 2nd frame – Ligaments and mucosal folds of the epitympanum were demonstrated.
  3. The 3rd frame – Spaces of the epitympanum were demonstrated.
  4. The 4th frame – Arrows depicting routes of cholesteatoma spread were shown.
- A questionnaire was then used to assess the utility of the Model. Responses were analyzed with SPSS Version 20.0. Proportions were compared with Fisher’s Exact Test or Pearson’s Chi-Square. A p-value of <0.05 was considered statistically significant.

RESULTS

21 medical students participated in this pilot project, of whom were 12 males (57.1%) and 9 females (42.9%).

<table>
<thead>
<tr>
<th>Question</th>
<th>% of Respondents who agreed</th>
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<tbody>
<tr>
<td>The anatomy of the epitympanum is difficult to understand</td>
<td>81%</td>
</tr>
<tr>
<td>Texts provided were easy to understand</td>
<td>14.3%</td>
</tr>
<tr>
<td>Texts provided were easy to understand with 2-D diagrams</td>
<td>33.3%</td>
</tr>
<tr>
<td>The Model helped in understanding the texts provided</td>
<td>90.5%</td>
</tr>
<tr>
<td>The Model helped in understanding and remembering the anatomy of the epitympanum</td>
<td>100%</td>
</tr>
<tr>
<td>The Model helped understanding spatial relations better than 2-D diagrams</td>
<td>100%</td>
</tr>
<tr>
<td>The Model will be useful to residents/students</td>
<td>100%</td>
</tr>
<tr>
<td>The Model will be useful to teachers</td>
<td>100%</td>
</tr>
<tr>
<td>I will want this resource if I were an ENT resident</td>
<td>100%</td>
</tr>
</tbody>
</table>

CONCLUSIONS

- The 3-D building block Model is a useful tool in making the anatomy of the epitympanum easy-to-understand.
- It can complement textbooks and 2-D diagrams to facilitate understanding and recall.

REFERENCES