The Case of Ken Lowery

Visual Knowledge Building and Translation of Volumetric Radiographic Imagery for Dynamic 3D Medical Legal Visualization

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Abstract

Volumetric imaging provides more comprehensive information than 2D imaging (e.g. CT scans and MRIs), but is more complicated to interpret, especially for a non-medical audience. This animation is designed to support medical expert testimony and provide a jury with an engaging, didactic experience to assist them in visualizing traumatic brain injuries three-dimensionally by incorporating volumetric imaging and animated sequences. A design research study of the 3D medical legal animation was conducted with a mock jury, personal injury lawyers, and medical experts. The pre/post-test results from mock jurors demonstrated 44% knowledge improvement, from 33% on pre-test to 77% on post-test.

Introduction

The purpose of this research project is to:

- Create a medical legal animation that incorporates volumetric radiographic imaging, combined with 3D anatomical models and animated sequences that conveys the full extent of the plaintiff's injuries.
- Evaluate the effect that these 3D visual explanations have on improving a mock jury's knowledge of the medical content and understanding of volumetric radiographic images by conducting a design research pre/post-test study.^{1,2}
- Obtain feedback from mock jurors, personal injury lawyers, and medical experts through design research survey results and focus group sessions on usability and utility of the 3D medical legal animation for courtroom demonstrative evidence.²

Materials & Methods

Media Design Methods

3D Models extracted from the plaintiff's CT data were cleaned and retopologized in Pixologic ZBrush (Fig. 1).

Figure 1. Process of restoring detail back to the 3D models from low resolution CT scan data.

Storyboards, 3D models, and animations were iteratively evaluated by committee members to obtain feedback on visual clarity and ensure anatomical accuracy (Fig. 2).

Throughout the development of the medical legal animation, specific design strategies^{2,3} were employed to help foster knowledge building and translation of complex case information.

- Transparency. To contextualize neuroanatomical spatial relationships and form connections between structures (Fig. 3a,b).
- Saturation. To focus viewer attention on areas of importance (Fig. 3b).
- Colour coding. To clarify, simplify, and group corresponding elements in radiographs and medical models (Fig. 3c,d).
- Model movement constraints. To tell a concise case story.

Figure 3. Still images from the 3D animation highlighting specific design strategies.

Research Methods

Twenty mock jury participants were asked to complete a pre-test based on case and radiographic image content before they viewed the animation, followed by a post-test with the questions randomized to examine knowledge improvement. An online design research survey was used to obtain formative feedback on multiple dimensions of media design and utility from mock jurors, personal injury lawyers and medical experts (n=32). A focus group debriefing session was conducted to obtain further information regarding the strengths and weakness of clarity of visual information, level of understanding, and overall educational design.

Figure 2. Storyboard image showing encephalomalacia.

Results

Pre/post-test results demonstrated a 44% increase in knowledge from 33% to 77% (Fig. 4). The range of scores on pre-test was 8% to 64% with a median score of 28%; the range of scores on post-test was 52% to 92% with a median score of 82%.

Figure 4. Neuroanatomy pre-test and post-test results from 20 mock juror participants.

Overall, mock jurors, lawyers, and medical experts agreed/strongly agreed that medical legal animations have an important role to play in juror understanding. They concluded that this animation would help the jury understand the medical story and neuro-radiological images presented in the case.

"It was absolutely helpful and would most definitely be beneficial for a jury" -Lawyer

Discussion & Conclusions

This design research study successfully demonstrated the need for 3D medical legal animations as a knowledge building tool, especially when volumetric radiographic imaging is involved. The utility and usability of 3D animation for demonstrative evidence was verified by lawyers and medical experts. Strong evidence in this study confirms the importance of medical legal visualizations and the impact they have on juror knowledge and understanding. Ultimately visual knowledge building scaffolds understanding of medical complexity, which translates to better decision-making in personal injury cases, such as that of Ken Lowery.

Bibliography

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