A Virtual Reality App for Viewing Radiotherapy Treatment Delivery

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Background

We have built an application that will allow patients to view an educational virtual reality (VR) experience showing the delivery of their radiotherapy treatment plan. With this VR experience, a patient can get a virtual preview of their daily radiotherapy treatment in advance. The goal of this study was to build a tool to improve patients' understanding of how radiotherapy will be used to treat their cancer.

Methods

We designed and built a novel virtual reality app that runs on the Oculus Quest [1], a commercially available virtual reality headset. The patient's radiotherapy plan is exported from our clinical treatment planning system in standard DICOM-RT [2] format. All DICOM-RT patient structures (e.g., target volumes, normal organs) are converted into 3D geometry meshes and saved in a standard OBJ and MTL file formats, along with accompanying color and transparency information (Figure 1).

Radiotherapy beam information is extracted from the DICOM-RT file (jaw positions, MLC positions, gantry angle, collimator angle, table angle, monitor units) for all beam control points, and saved into an intermediate file format, YAML [3], and then imported to the Oculus Quest. Using Unity [4], we created a virtual environment of a treatment vault which contains a 3D model of a linear accelerator with a fully movable patient table and gantry head (gantry & collimator angles) with adjustable multi-leaf collimator (MLC) leaves. A full-scale 3D rendering of the relevant part of the patient's body is shown in position on the treatment table with a translucent body contour so that the target volume and internal normal organs can be seen.

Results

To date we have enrolled a total of 40 patients who were preparing to receive radiotherapy. Of those surveyed, 31 (78%) indicate that they "strongly agree" that the VR session gave them a better understanding of how radiotherapy will be used to treat their cancer. Of the 20 patients who expressed any anxiety about radiotherapy beforehand, 12 (60%) said the VR session helped decrease their anxiety about undergoing radiotherapy.

![Figure 1: Example of anatomic structures taken from the radiotherapy treatment planning system, exported as DICOM, and converted into 3D geometry meshes as OBJ files for import into the virtual reality headset.](image)

A table showing the distribution of disease sites among the patients:

<table>
<thead>
<tr>
<th>Disease Site</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>breast</td>
<td>18</td>
<td>(45)</td>
</tr>
<tr>
<td>prostate</td>
<td>11</td>
<td>(28)</td>
</tr>
<tr>
<td>lung</td>
<td>4</td>
<td>(10)</td>
</tr>
<tr>
<td>esophagus</td>
<td>3</td>
<td>(8 )</td>
</tr>
<tr>
<td>rectal</td>
<td>2</td>
<td>(5 )</td>
</tr>
<tr>
<td>endometrial</td>
<td>2</td>
<td>(5 )</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>40</td>
<td>(100)</td>
</tr>
</tbody>
</table>

![Table 1: Disease Sites](image)

![Figure 2: Virtual reality depiction of radiotherapy treatment delivery.](image)

Conclusions

We created a novel app that can emulate the delivery of a patient's radiotherapy treatment plan on a wireless virtual reality headset. We are studying the use of this app in a prospective clinical trial to determine if this VR tool can improve patient understanding and/or reduce anxiety about their radiotherapy treatment. Our prospective clinical patient trial demonstrates that this VR experience gives patients a better understanding of how radiotherapy will be used to treat their cancer, and it decreases their anxiety about undergoing radiotherapy treatment.

References


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- This study was approved by the Salem Hospital Institutional Review Board.