Virtual Reality as a Complimentary Therapy to Improve Pain in Sickle Cell Disease

Simon Robertson
Founder / CEO KindVR
My Background

• Game designer wanting to do more than entertain
• Started volunteering in 2014
• Doctors at UCSF Benioff Children’s Hospital Oakland encouraged collaborative exploration of VR as a therapeutic tool
• Research began in 2015
• Honored to be invited to share our findings
What is Virtual Reality (VR)?

• Tool capable of tricking the brain’s senses
  • Visual System – Realtime stereo 3D images
  • Auditory System - Realtime 3D spatial audio
  • Low latency head tracking, updating the virtual world as you look around
• Creates sense of presence
• Cognitive tasks to engage the mind
• Burn patients reported an average 35% reduction in pain while in immersive VR

• Equipment was expensive ($35,000) and cumbersome (desktop computer based) but it worked!

“VR may reduce pain by directing patients’ attention into the virtual world, leaving less attention available to process incoming neural signals from pain receptors.”

Hunter Hoffman, PhD
Senior Research Scientist
University of Washington

Synergistic with Opioids

Our Current Project

Specific Aim 1: To test the **usability and acceptability** of immersive virtual reality technology in sickle cell patients hospitalized with pain.

Specific Aim 2: To determine if a virtual reality immersive experience serves as an **effective adjunctive therapy to traditional pain reduction treatments** in patients with sickle cell disease hospitalized due to pain.

**IRB:** Approved November 2015

**Start Date:** December 2015

**Progress:** 25 of 30 patients enrolled

**Primary Investigator:** Dr. Anne Marsh
Research Team
UCSF Benioff Children’s Hospital Oakland

Anne Marsh, MD
Hematology / Oncology
UCSF Benioff Children’s Hospital Oakland

Anu Agrawal, MD
Hematology/Oncology
UCSF Benioff Children’s Hospital Oakland

Chris Vlasses, MD
Pediatric Hospitalist
UCSF Benioff Children’s Hospital Oakland

Marsha Treadwell, PhD
Mental Health & Child Development
UCSF Benioff Children’s Hospital Oakland

Simon Robertson
kindVR Founder & Lead Design

Carolyn Hoppe, MD
Hematology/Oncology
UCSF Benioff Children’s Hospital Oakland

Erica Tringale
RN, MS, C-PNP
UCSF Benioff Children’s Hospital Oakland

Liat Litwin
Medical Student
Sackler School of Medicine
Study Methods

• 15 Minute VR intervention bedside with SCD patients experiencing vaso-occlusive pain

• Participants completed a pain tool and a simulator sickness survey pre- and post-VR experience

• Participants completed a post-study questionnaire
Measurement - Adolescent Pediatric Pain Tool (APPT)

Place a straight up and down mark on this line to show how much pain you have.

- No pain
- Little pain
- Medium pain
- Large pain
- Worst possible pain
Measurement - Adolescent Pediatric Pain Tool (APPT)

1. annoying
2. bad
3. horrible
4. miserable
5. terrible
6. uncomfortable
7. aching
8. hurting
9. like an ache
10. like a hurt
11. sore
12. beating
13. hitting
14. pounding
15. punching
16. throbbing
17. biting
18. cutting
19. like a pin
20. like a sharp knife
21. pin like
22. sharp
23. stabbing
24. blistering
25. burning
26. hot
27. cramping
28. crushing
29. like a pinch
30. pinching
31. pressure
32. screaming
33. terrifying
34. itching
35. like a scratch
36. like a sting
37. scratching
38. stinging
39. shocking
40. shooting
41. splitting
42. numb
43. stiff
44. swollen
45. tight
46. awful
47. deadly
48. dying
49. killing
50. screaming
51. terrifying
52. dizzy
53. sickening
54. suffocating
55. never goes away
56. uncontrollable
57. always
58. comes and goes
59. comes on all of a sudden
60. constant
61. continuous
62. forever
Patients explore and interact within a comfortable underwater world.

Offers both active and passive gameplay, allowing patients to either challenge themselves or to simply relax.

Designed to accommodate patients’ needs including limited mobility, range of motion, and various levels of familiarity with interactive games.
Patient Demographics

N = 25
Mean Age: 16.8 yrs
Range: 10 – 25 yrs
Female: 19 (76%)

Sickle Cell Genotypes:
SS: 18 (72%)
SC: 5 (20%)
S/beta+ thalassemia: 2 (8%)
Reduction in Body Areas Affected (-23%)
Reduction in Pain Intensity (-16%)
Reduction in Pain Descriptors (-33%)
Simulator Sickness Ratings Declined

Simulator Sickness Questionnaire

<table>
<thead>
<tr>
<th>Question</th>
<th>PRE</th>
<th>POST</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does your head hurt?</td>
<td>4.2</td>
<td>3.3</td>
</tr>
<tr>
<td>Do your eyes hurt?</td>
<td>2.1</td>
<td>1.7</td>
</tr>
<tr>
<td>Do you have an upset stomach?</td>
<td>3.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Do you feel dizzy?</td>
<td>3.0</td>
<td>2.3</td>
</tr>
</tbody>
</table>
## Positive Feedback on VR Experience

<table>
<thead>
<tr>
<th>VR Experience Feedback</th>
<th>Question</th>
<th>Average Score (0 - 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Immersion</strong></td>
<td>How much did you feel like you were inside the virtual world?</td>
<td>9.2</td>
</tr>
<tr>
<td><strong>Felt Real</strong></td>
<td>How real did Aqua feel to you?</td>
<td>8.4</td>
</tr>
<tr>
<td><strong>Fun</strong></td>
<td>How much fun did you have while playing Aqua?</td>
<td>9.4</td>
</tr>
<tr>
<td><strong>Comfortable</strong></td>
<td>Playing Aqua was comfortable.</td>
<td>9.6</td>
</tr>
<tr>
<td><strong>Hospital Experience</strong></td>
<td>Playing Aqua made me feel better about my hospital stay.</td>
<td>8.6</td>
</tr>
<tr>
<td><strong>Play Again</strong></td>
<td>I would play Aqua again when I am in pain.</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Sickle Cell Program
• Ongoing project with possible expansion into adult population

Oncology Program
• Port access study

Chronic Pain & Biofeedback
• Teach pain-coping strategies to pediatric oncology patients using guided meditation and biofeedback.

MRI Virtual Practice
• Improve MRI outcomes through patient practice in a safe setting. Goal to reduce need for anesthetic.
Looking Forward . . .

A Software Platform with Clinically-Validated VR Experiences

Aqua
*Pain & Stress*
- Cancer
- Burn Wounds
- Sickle Cell Disease
- Pre / Post Operative

**Guided Meditation**
*Chronic Pain & Stress*
- Pain Coping Strategy
- Teaching Tool
- Biofeedback – Heart Rate & Respiratory

**MRI - Virtual Practice**
*Education & Training*
- Staying Still
  “Practice through Play”
- Improved Imaging Outcomes
Thank You!

Simon Robertson

e-mail: simon@kindVR.com

twitter: @SimonRobertson @kindVR