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Patient Engagement in Virtual Reality as an Adjunct to Upper Limb Burns Rehabilitation

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Background

The rehabilitation of a burn injury is an integral part of burn treatment and is an extended process, continuing for months after the initial event. For patients with injuries due to burns, participating for the duration of therapy is a challenge, as an increased range of motion is often associated with higher discomfort or pain. The motive behind a virtual reality system for occupational therapy upper limb rehabilitation is to provide the **opportunity for participation in meaningful activity** for persons that have suffered from a burns injury.

Virtual Reality Game Interventions

The **Oculus Quest** is an immersive **virtual reality headset** hosting the game, Beat Saber. The game requires the user to 'slash' music beats using the upper limbs. The movements required by Beat Saber and **Nintendo Wii Sports** are similar and upper limb dominated, where specific movement patterns resemble those used for burns occupational therapy.

Primary Aim

To enhance the quality and meaningfulness of rehabilitation, and to compare patient satisfaction and engagement in immersive and non-immersive virtual reality.

Secondary Aim

To propose and investigate tools to improve the way movement is assessed and to consequently provide kinematic evidence for patient engagement.

Ethical Approval

Ethical approval was granted by the RBWH HREC. HREC/2020/QRBW/70050

Methods

This project was a pilot repeated measures study. Participants recruited were current in-patient and out-patients of the **RBWH Occupational Therapy Upper Limb Rehabilitation Group**. Five (5) patients were asked to complete a virtual reality game therapy protocol whereby they interacted with the non-immersive game Nintendo Wii and the immersive virtual reality headset Oculus Quest.

To qualitatively measure patient experience of interaction with virtual reality games, a user satisfaction questionnaire was distributed. To quantify the amount of engagement exhibited by patients during the study, the video-based motion capture software **OpenPose** was used.

Qualitative Results

Patients recorded that the Oculus Quest was **"a lot of fun"** , beneficial for **"moving their arms"**, and **"good to do something different with technology to help the rehabilitation process".**

Some reported the Nintendo Wii as **"very beneficial"** and a **"great system for rehabilitation"**.

Questionnaire Results

Question	Oculus Question n = 5		Nintendo Wii n = 3	
	Mean	SD	Mean	SD
Q1. Did you enjoy your experience with the system?	5.00	0.00	4.67	0.58
Q2. Were you successful using the system?	4.20	0.45	4.33	0.58
Q3. Were you able to control the system?	4.40	0.55	3.33	0.58
Q4. Is the information provided by the system clear?	4.80	0.45	4.33	1.15
Q5. Did you feel discomfort during your experience with the system?	4.20	1.67	4.33	1.15
Q6. Do you think that this system will be helpful for your rehabilitation?	4.60	0.89	4.67	0.58
Q7. Did you feel nausea during your experience with the system?	4.80	0.45	5.00	0.00
Q8. Did you feel fatigue during your experience with the system?	4.80	0.45	4.00	1.00
Q9. Did you feel stiffness during your experience with the system?	4.80	0.45	4.33	0.58
Q10. Were you able to comfortably hold the hand-held remotes?	4.80	0.45	5.00	0.00

Discussion

The use of Oculus Quest was mostly successful across the patient group. Patients early in their rehabilitation had considerably limited range of motion and consequently had lower levels of participation at slower paced games. Patients further along in their progression of rehabilitation were able to actively participate at higher game speeds to complete multiple rounds of the Beat Saber levels.

The questionnaire results consistently **favour the use of the Oculus Quest** when compared to the Nintendo Wii in terms of **enjoyment, control, stiffness to the upper limb,** and **level of fatigue.**

Conclusion

The results obtained **support increased patient satisfaction and engagement in rehabilitation programs with use of the Oculus Quest** headset to play the immersive virtual reality game Beat Saber. Consequently, the use of immersive virtual reality games should be employed as a therapy tool in the Occupational Therapy Upper Limb Burn Rehabilitation Group. Furthermore, the use of OpenPose in this clinical environment demonstrates the greater potential for use of the software as a non-invasive, affordable, and effective method for kinematic analysis and quantification of therapy induced movements for patients.