Exploration of rehabilitation through the use of virtual reality interventions for patients with upper limb conditions: protocol for scoping review.

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ABSTRACT

Background

The use of virtual reality to aid rehabilitation of upper-limb conditions has been an emerging field over the past decade. The majority of research seems to focus on post-stroke therapies with major advances in improving hand function through various robotic and digital techniques (1), however it is still not standard practice. With the recent crisis of COVID 19, home therapy has been thrust into the forefront of rehabilitation.

At present a wide variety of technology has been developed to target rehabilitation in the upper limb. This includes hand tracking technology (e.g. Leap Motion) where various prototypes have been tested using haptics (2), robotic-assisted movement devices which predominantly target stroke or neurorehabilitation by means of exoskeleton prototypes (3,4), and exercise programmes through telerehabilitation and virtual reality (5). The majority of hand devices that have been developed are bulky and can impact on the accuracy of functional measurements (6).

In terms of virtual reality, studies suggest that patients find it enjoyable and are as, if not more, motivated in these rehabilitation sessions when compared to traditional exercises, even in the older population (7). Hoffman *et al* in 2020 (8) found that patients undergoing hand rehabilitation with virtual reality felt that their pain was reduced, they had increased levels of motivation and therefore felt more able to perform exercises. This has been matched by studies looking at pain and anxiety levels whilst using virtual reality during wide awake anaesthesia with a significant reduction in both (9).

Hand rehabilitation outside of stroke and neurological disorders, for example post-surgery or trauma, involves intensive hand rehabilitation by the hand therapy team but there is a global shortage of this service. Current practice is one-to-one patient-to-therapist and involves intensive rehabilitation, assessment and documentation. Virtual reality could prove a vital technology to develop to enable patients to undertake immersive therapy within their own homes whilst allowing remote assessment of their progress and function from the hand therapy and clinical teams.

Aims

The overarching aim of this review is to identify the range and variety of virtual reality tools that are available and effective for upper limb conditions.

Review objectives

1) What is the "extent (size), range (variety) and nature (characteristics) of the evidence" of virtual tools to enhance hand rehabilitation?
2) Do these tools have the potential to be used in the field of hand surgery and hand rehabilitation?
3) What are the barriers and facilitators to hand rehabilitation using virtual tools?

<u>Design</u>

The scoping review will be conducted in accordance with PRISMA-ScR guidelines (10) and the frameworks developed by Arksey and O'Malley (11) and Levac et al. (12). Preliminary searches will be conducted and two librarians will be consulted to create a comprehensive search strategy. Screening of titles and abstracts will be undertaken by three independent reviewers, with conflicts resolved by discussions and consensus. Full-text screening will be undertaken following this same approach. A charting form will be developed based on the objectives of the review and refined by the research team. Data will be collated and summarised, with quantitative sources described descriptively and qualitative data analysed thematically (13). Results will be presented using summary tables and/or using pictorial/flow charts, if appropriate.

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Steps

1   Protocol and registration: The protocol for this scoping review is publicly available from protocols.io.

2   Eligibility criteria: All study types including controlled, validation, evaluation, observational studies, conference proceedings and abstracts will be included, published between 2010 – 2020, involving only human studies and written in English. Studies will be excluded where no full text is available or which meet the following criteria: paediatrics, prosthetics, brain studies e.g.: Electromyography/Electroencephalogram, Brain-computer interface /deep brain stimulation, neurological conditions e.g Parkinson's disease, virtual reality that only addresses cognitive rehabilitation, telemedicine, robotics and/or exoskeletons. The reasons behind these chosen criteria are to enable the review to focus on studies using the latest technology and avoiding studies which would not be relevant in the field of hand surgery or

hand trauma.

3   Information sources: A list of comprehensive search terms and strategy will be developed and reviewed by the scoping review team with the support of two librarians. Once this is agreed, a search of the following databases will be undertaken: CINAHL, Medline, EMBASE, Scopus, Web of Science, PsychInfo and Epistemonikos for all relevant studies between 2010 – 2020 to ensure that ongoing and recently completed studies are not missed. The relevant publications identified will be uploaded to Mendeley, a web and desktop reference management system for collaborative use amongst the reviewers.

4   Search strategy: The preliminary search terms have been discussed with two academic librarians and will include; 'immersive virtual reality', 'hand' and rehabilitation'. Virtual reality/digital tools (defined in accordance with the World Health Organisation classification of digital health interventions v1.0 (14)) will be included in the review.

5   Selection of sources of evidence: Initially titles and abstracts will be assessed by three independent reviewers to confirm the eligibility criteria. Screening of titles/abstracts will be divided amongst the review team. There will be regular discussion with the rest of the reviewers during this process for any queries or disputes. Full text screening will then be undertaken using the same procedure. The reference lists of key studies will also be searched by hand and relevant papers will be extracted from this.

6   Data charting process: Data will be charted into a Microsoft Excel form, based on the objectives of the review. The charting form will be available on an online portal (Google Sheets) allowing the team to see each other's contribution and discuss any concerns.

7   Data items: Extracted data will be based on the objectives of the review, including the type and contents of the virtual/digital tool, experience of users and barriers/facilitators of the use of virtual reality for hand rehabilitation.

8   Synthesis of results: Quantitative data will be collated and synthesised descriptively. Thematic analysis will be used to synthesise any qualitative data, using the staged approach by Braun and Clarke (13). Collation and synthesis of findings will be undertaken by members of the research team based on experience with quantitative and qualitative analysis.