A critical appraisal of "Increasing upper limb training intensity in chronic stroke using embodied virtual reality: a pilot study"

By

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Abstract

This paper serves as a clinical appraisal resource for the article, “Increasing upper limb training intensity in chronic stroke using embodied virtual reality: a pilot study” published through the Journal of NeuroEngineering and Rehabilitation in 2017. The clinical question that led to the selection of this article will be introduced as well as an analysis of the introduction, methods, results, and discussion of the article. The significance of the article’s findings will also be addressed in the discussion as well as the applications that arise from the study.

Key words: Upper Extremity, Range of Motion (ROM), Stroke, Virtual Reality (VR)

Introduction

This appraisal is meant to explore research surrounding potential treatments for chronic strokes which affect millions per year with many patients requiring physical therapy interventions. Although current traditional interventions follow an evidence-based approach, thereby making them effective, it is important to explore other options that may further improve patient outcomes for stroke patients. This led to research surrounding virtual reality (VR) gaming as a potential intervention due to increasingly stimulating technological advancements in recent years. This research contributed to the formation of the research question, "Is virtual reality (VR) an effective exercising implement to improve range of motion for patients recovering from stroke?"

Methods

Due to PubMed's generally reputable reputation as a resource, the search for an article was conducted using PubMed. The words "range of motion," "stroke," and "virtual reality" were the selected keywords because they were the main focuses of the research question. Of the results, only clinical and randomized control trials retroactive to 2017 were included. The following timeframe was selected due to the rapidly evolving video game industry. Upon implementing the limitations, seven articles remained to review. After narrowing down the seven articles to three, it was decided to focus on an article titled, "Increasing upper limb training intensity in chronic stroke using embodied virtual reality: a pilot study."

The selected research article was led by Dr. Daniel Perez-Marcos and published by the Journal of NeuroEngineering and Rehabilitation in 2017. The prospective experiment was conducted in Switzerland surrounding ten chronic stroke patients recruited from the "Clinique Romande de Réadaptation" in Sion, Switzerland. This study was selected due to its ability to

provide up-to-date, valid data surrounding virtual reality and stroke recovery that directly addresses my research question in a clear and concise manner.

Results

Summary of the study

Strokes affect around 17 million people per year and current trends show a continuous increase. What is particularly concerning is that five years after the first stroke, nearly 66% of patients exhibit different degrees of disability and 90% of stroke survivors suffer from some form of upper limb motor disability. This 2017, single-group and blinded-assessor intervention study analyzed the efficacy of a virtual reality (VR) system for upper extremity focused movement training for ten outpatient stroke survivors with hemiparesis. For five weeks, participants, under the supervision of a physical therapist, completed two sessions of VR weekly totaling approximately ten hours of play time in game-like scenarios. A blind assessor evaluated participants at their baseline prior to training, post treatment twenty minutes after their final training session, and then at a four week follow up. The study found improvement in AROM for shoulder flexion, wrist extension, forearm supination, and forearm pronation with no notable increase in pain levels during treatment. This showed that VR may be a feasible for increasing range of motion and functionality for the upper extremities of stroke victims although more research is required.

Appraisal of the study introduction

The introduction provides adequate information first introducing stroke prevalence as well as long term effects and treatments that accompany it. It later introduces VR as a potential tool for motor rehabilitation that provides opportunities to practice stimulated functional tasks at

a higher frequency than traditional therapies. They also do an adequate job in explaining how the two concepts overlap in previous studies which leads to a very general explanation as to how the experiment will be conducted. It also appears that the articles referenced in their introduction consistently come from reputable resources such as PubMed and there is no trend showing a reliance on articles that share the same journal. The introduction does a good job clearly stating a hypothesis as well as three primary goals of the project which makes following noticeably easier compared to many other articles

Although the introduction is comprehensive, there is more information that may have been beneficial such as the specific games that will be utilized (although it is covered later) as well as accessibility of VR. They could have also talked more about how video gaming in general is becoming more and more popular, which is possibly the main reason why VR is considered in the first place. It would have also been beneficial to see them explain more just a bit more in detail on what data was collected (AROM, etc.) Lastly, although most of the references cited are relatively recent, some are alarmingly older such as a 1986 study that was referenced.

Appraisal of the study methods

Although not explicitly stated, the study's methods presented itself as a prospective, quasi-experimental, longitudinal study. There is sufficient data provided that give context to the demographics of the group being studied such as age, time since stroke, and sex. The schedules are clearly written as well as clear declaration of the project being classified as single group and a blind-assessor study. Given how broad VR can be, the methods section does a good job in giving a description of the program used as well as the type of games utilized. The data collected

was clearly categorized with bolded titles and a brief description and their data analysis section did an adequate job in providing reasoning for tests and other data analyses usage.

A clear limitation of the methods was not blinding the subjects being tested. Another limitation is that although the subjects were selected based off an exclusion/inclusion criterion, their background information varied greatly, such as participants ranging from 34 to 72 years old and time post stroke ranging from 6 to 108 months.

Appraisal of the study results

The authors did an excellent job presenting their findings in a manner that follows an identical pattern in the methods section, separated into primary and secondary outcomes. The tables provided were relatively easy to follow and interquartile ranges were also provided. Lastly, the information provided covered both objective data, such as active range of motion measurements, as well as qualitative data, such as pain, tolerance to VR intervention which offered a more holistic approach to the study.

The tables bring forth a lot of data which can make it difficult to follow. Minor aesthetic changes such as including lines to separate data could make the information easier to follow. Providing some sort of bolding or highlight around statistically significant information both in tables and writing could also be beneficial to help the audience more easily absorb the main points of the section.

Appraisal of the study discussion

The authors did a good job in making multiple points explaining the meaning of the findings. For example, they explained how the results support recent evidence indicating that

VR-based treatments after stroke can be more efficient than conventional therapy due to its higher activity rate. The paper also properly referenced other studies and compared results to make their study and results appear more reliable to the reader and bring forth a more meaningful discussion on the ramifications of the study. Lastly, the study did an excellent job in addressing their limitations and acknowledging improvements may be made to the study.

Although the study made efforts to explain how the results may be clinically significant, it would be beneficial to have a dedicated area to clarify the potential applications of the study. Despite a hypothesis being presented in the introduction, it was not directly addressed in the discussion although the data makes it appear that it is in fact supported. Although limitations are specified in the discussion, an additional factor that was not directly addressed were lifestyle factors during the data collection, as there may have been possible alternative confounding variables that have contributed to the study. Lastly, the severity of stroke in participants was not explained in detail, which could greatly impact one's response to interventions.

Discussion

The study is clinically significant to the evolution of physical therapy and ensuring that clinicians are truly utilizing the most beneficial intervention(s) for increasing upper extremity function in those who have suffered a stroke. Although the article focuses on VR as an intervention, it does an excellent job in emphasizing the general idea that increasing intensity may improve patient outcomes. This study is particularly valuable with reference to my research question because it directly addresses the main points posed. Specifically, it utilized VR intervention following a specific group of stroke victims and continuously assessed multiple data points, with one being AROM, thereby offering a valid perspective regarding my research question.

The implementation of VR within rehabilitation is a relatively novel concept that needs a lot more exploring. With that said, the potential benefits as seen in this study merit more consideration of its usage. VR systems can offer simulated practice of many function tasks at a higher dosage than conventional therapies and can be completed at home depending on the type of VR utilized. This can lead to increased rehabilitation dosages administered within rehabilitation settings thereby leading to improved patient outcomes. Given the novelty of VR, there is still much to be wary of when considered as an intervention. For one, VR can be expensive, therefore reducing accessibility for underprivileged populations. VR can also be addicting like many other games and lead to unintended consequences. On the other hand, patients may be disoriented after playing video games for longer periods of time than they are accustomed to and not respond well to treatment. Furthermore, there is not much research surrounding VR and its efficacy so it is difficult to argue its true functionality in comparison to traditional therapies. Additional research using a control group, larger sample sizes, and more analysis of lifestyle factors that may impact results will be required to improve the argument supporting the intervention. Lastly, this study was funded and conducted by employees of MindMaze SA, the creators of the VR intervention being studied. This is a significant red flag and merits additional research from independent researchers without a conflict of interest.

I am not yet confident in the research's validity to implement VR with future clients. Although the paper is written well and experiments are conducted in a safe and effective manner, the severe conflict of interest as well as smaller sample size and lack of outside activity analysis leaves multiple question marks regarding the reliability and validity of the study. With that said, I am open to the idea of implementing VR as a supplemental intervention in the future if there is continued evidence to support its usage. Although the research is limited, there are multiple

studies supporting its efficacy as an intervention. However, the appraised article is a self-identified pilot study and should be treated as such. Using this article alone that is meant to be a preliminary study for larger future studies, I do not anticipate implementing VR in the clinical setting in the near future. However, with future larger and more conclusive studies on the horizon, it would be prudent to conduct further appraisal to determine VR's efficacy in the clinic and if it should be implemented.

To conclude, the article focused on the potential benefits of VR intervention for ten chronic stroke patients and used multiple forms of data to track their progression. Based on the article's role as a pilot study, it is valid and reliable enough to warrant additional research, but neither valid nor reliable enough to justify its implementation in clinical settings. Although there are many limitations to the study, there is potential for benefit with more thorough research, although there is no proof that VR implementation alone should constitute physical therapy. Further research addressing the limitations should be explored.