

## **Abstract**

### Introduction

Virtual reality is able to simulate conditions, which would be very hard to imitate in common practise and therefore it brings much more complex perception (optical and auditory incentives), it has positive influence on psychical state and at the same time increases motivation. Commonly available games do not have the therapeutical effect and do not provide any feedback about performed move. Because of the reasons mentioned before, the objective of this thesis was to develop and also optimalize speacially designed physiotherapeutic feedback-providing program in virtual environment for a purpose of increasing functionality of upper limb, improving sitting balance and quality of getting up of patients suffering from multiple sclerosis (MS).

### Method

Prospective study has been realized by Clinic of rehabilitation medicine FNKV in Prague and Third Faculty of Medicine at Charles University in cooperation with Faculty of Applied Sciences at University of West Bohemia in Pilsen. Development of the rehabilitative application began in May 2019, the testing took place from October 2019 to August 2020. Patients suffering from multiple sclerosis with upper limb disorder have been chosen based on advertising of the study in MS centers, ROSKA Union and via SMS in two waves (first and second cohort). First cohort has completed 15 therapies, each lasting 45 minutes, while using the first version of the therapeutic application, second cohort has completed 10 therapies each also lasting 45 minutes, while using enhanced version of the application. The therapy took place in virtual environment mediated by HTC Vive, which has been directed and controlled by the therapist in real time. The therapeutic unit itself has been composed of diagonals based on the Proprioceptive neuromuscular facilitation method (I. and II. diagonal), getting up practice and collecting of fixed balls. Every proband was set in postural positions activated throught Motor Programs Activating

## Therapy method.

Resulting therapeutical effect on upper limb functionality was evaluated via clinical tests (Hand Grip, Nine-Hole Peg Test, 9HPT, Box nad Block, BBT, measuring of postural tremor using accelerometer), pace of getting up (Five times Sit to Stand Test, 5STS) and also via addition of questionnaires (MSIS-29, EQ-5D-5L-health Questionnaire, A 7-point Likert-type Global Rating of change Scale, GRS and questionnaire about virtual reality).

## Results

Six of twenty two people, who have been addressed, have participated in the study, three in the first cohort and three in the second cohort. The average age of participants was 54 years, average duration of disease was 14,7 years and their average value on Expanded Disability Status Scale (EDSS) was 3,4. Every volunteer had relaps-reminent form of multiple sclerosis. Within the first cohort there was an increase in amount of relocated cubes on left ( $p=0,009$ ) and also on right ( $p=0,037$ ) upper limb and there was a growth in pace of getting up 5STS ( $p=0,044$ ) as well. Within the second cohort there was an increase of speed in 9HPT ( $p=0,046$ ). On average within the both cohorts, there was a significant improvement of muscle strenght on left upper limb ( $p=0,037$ ), increase in amount of relocated cubes in BBT on right upper limb ( $p=0,022$ ) and growth in pace of getting up 5STS ( $p=0,011$ ). Based on questionnaires, we can confirm decrease of multiple sclerosis' impact based on MSIS-29 questionnaire within both cohorts ( $p=0,028$ ) and trend of improvement based on EQ-5D-5L-Health questionnaire and A 7-point Likert-type Global Rating of change Scale.

## Conclusion

Using HTC Vive platform, optimized physioterapeutic program in virtual reality has a positive effect on upper limb functionality and pace of getting up, but it is necessary to optimize therapeutical application basen on questionnaire about virtual reality experience, clinical experience and verify it on higher amount of probands afterwards.

**Key words:** virtual reality, multiple sclerosis, Motor Programs Activating Therapy, Proprioceptive neuromuscular facilitation, examination of the upper limb, clinical tests