

Original Research Article

Effect of Virtual Reality Training on Psychosocial Factors in Spinal Cord Injury Patients

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ABSTRACT

Background: Spinal cord injury is one of the leading causes of disability in today's world. Paralysis of the muscles can lead to limited mobility, self care and participation in social activities. The psychosocial impact of the episode is as great as the physical impact. Psychosocial factors profoundly affect a patient's ability to recover. Treatment outcomes will be influenced by patients' perception to their role in the rehabilitation process. Physical therapy is a long-term and tedious process especially in patients with SCI and hence stimulating patients' motivation is a major concern. VRT helps reduce monotonicity and increase interest, attention and concentration. VRT leads to more patient involvement, better attention, better learning and retention of skills and helps in boosting the confidence of the patients.

Method: 17 patients (age: 33.94±12.61 years) who matched the inclusion criteria were recruited. 16 patients completed the intervention. On recruitment, baseline measurements were done using the outcome measures. After recruitment, intervention with virtual reality training for 12 sessions over a period of 4 weeks was done. After intervention, post assessment was done.

Results: There are significant changes seen in the psychosocial factors post intervention with $p < 0.05$. Patients reported decrease in stress and anxiety and more calmness post intervention. Participants got better at playing the games with each successive session.

Conclusion: This study concludes that virtual reality training holds great potential to be a therapeutic tool in improving psychosocial factors in spinal cord injury patients.

Keywords: Spinal cord injuries; psychosocial factors; virtual reality training; rehabilitation

INTRODUCTION

Spinal cord injury is one of the leading causes of disability in today's world. ⁽¹⁾ It is a high cost injury that results in tremendous changes in an individual's life. ⁽¹⁾ There is a loss of physical as well as sensory stimulation in spinal cord injury patients due to loss of descending input to spinal networks. There is an absence of physiological proprioceptive input to the

spinal cord which otherwise leads to meaningful muscle activations during movement performances. ⁽²⁾ Paralysis of the muscles below the level of injury can lead to limited and altered mobility, self care and ability to participate in valued social activities. The psychosocial impact of this episode is as great as the physical impact. Changes in body image, sexual functions, incontinence and having to rely on others

for daily activities which were done effortlessly earlier, changes an individual's personality.

Psychosocial factors pertain to the psychological development of an individual in relation to his or her social environment. (3) Male to female ratio in SCI incidence is seen to be varied from 1.6:1 to 13.5: 1 in various studies. In India, males are 4 times more prone to SCI than females. (4) The moderate socio-economic status and younger age group have a major financial, social and psychological impact as majority of the patients (males) are the primary earning members of the family in India. (4)

Psychosocial factors profoundly affect a patient's ability to recover. Patients who are emotionally upset will have difficulty concentrating on physical therapy goals until emotional issues are addressed. Mental health status has been shown to be one of the most important predictors of physical health. (5) More than 50% of all visits to primary care doctors involve somatic complaints resulting from psychosocial problems. (6) Multiple psychosocial factors play a great role by affecting the resilience in people who sustained SCI. (7) Treatment outcomes will be influenced by patients' perception to their role in the rehabilitation process. Patients who believe that they possess responsibility and are a part of their own rehabilitation process show better outcomes. (8) The mind and body are highly connected and because of their reciprocal influence, psychosocial, and physical issues should be addressed simultaneously to best facilitate recovery. (9) Health outcomes tend to be poor and prolonged when psychosocial problems remain unaddressed. (10)

Patients with spinal cord injuries have reported higher levels of psychosocial issues like depression and anxiety as compared to general public, the onset of which has been linked to the presence of an existing physical disability. (11) Disabilities of sudden onset as seen in SCI often lead to experience of anxiety and

shock followed by denial, anger and depression. The patient perceives the situation as a crisis that will affect and change their life for all time. (12) Severe psychosocial issues may escalate quickly and impair all aspects of patient's life, including rehabilitation outcomes by intensifying the perception of pain, inhibiting immunosuppression and prolonging recovery time. (12) Physical therapy is a long-term and tedious process especially in patients with SCI as there is delayed regeneration due to altered abilities of the axons to regenerate (13) and hence stimulating patient's motivation is a major concern. Virtual reality training games helps reduce monotonicity and increase interest, attention, focus and concentration in patients with SCI. (14) Virtual reality training also leads to more patient involvement, better attention, better learning and retention of skills and helps in boosting the confidence of the patients.

MATERIALS AND METHODS

Spinal cord injury patients who met the inclusion criteria of the study were recruited. The study was done on 17 patients. All the patients were given consent forms which contained the details of the project. Participants between the ages of 18 to 60 years were recruited for the study. The mean age of the patients was 33.94 ± 12.61 years. There were 13 males (dropped out =1) and 4 females in the study. The patients who had a spinal cord injury 3 months ago or more were included in the study. Also, patients who had a lower cord injury (T8 and below) and had good upper limb control were included. Patients already on medications for psychological disorders, having visual affection and difficulty in understanding commands were excluded from the trial. Also, patients having any other neurological diseases like multiple sclerosis, Parkinson's disease, traumatic brain injury were excluded. One patient dropped out of the trial after one week of recruitment.

The participants of the study were assessed using WHOQOL BREF ⁽¹⁵⁾ and DASS 21 ⁽¹⁶⁾ and baseline measurements were taken. The patients continued to do their conventional therapy throughout the intervention period. Conventional therapy consisted of weight bearing activities for upper limb and lower limb, task-oriented reaching and manipulation activity for upper limb, transfers like sit to stand, walking in parallel bars, balance training in standing, trunk rotation activities in sitting using pegs. After the baseline measurements were taken, intervention was started. Intervention using virtual reality training consisted of 12 supervised sessions over a period of 4 weeks i.e. three sessions per week was done. The intervention consisted of patients playing virtual reality games like tennis and ski for 30 minutes. The virtual reality training sessions were generally taken post conventional treatment to maintain similarity in the study. After 12 sessions of virtual reality training, post interventional assessment was taken using the same outcome measures.

Statistical Analysis:

Statistical analysis was done using SPSS 16 software. Wilcoxon signed-rank test was done for pre and post measurements, within the group for all components of the outcome

measures. A level of probability of $p < 0.05$ was considered statistically significant.

RESULTS

Table 1 shows the results of WHOQOL BREF questionnaire domains.

The WHOQOL BREF questionnaire has 4 domains namely physical, psychological, social and environmental domains. All domain scores (mean±SD) for pre and post intervention has been mentioned in Table 1. A statistically significant change with $p = 0.047$ was obtained for the physical domain. Also a statistically significant change with $p = 0.008$ was obtained for the psychological domain. The social domain too showed a statistically significant change with $p = 0.011$. However, no statistically significant changes were seen in the environmental domain with $p = 0.119$.

Table 2 shows the results of DASS 21 components.

The DASS 21 scale has 3 components namely depression, anxiety and stress. All components' scores (mean±SD) for pre and post intervention has been mentioned in Table 2. Statistically significant changes with $p = 0.039$ for depression and $p = 0.001$ for anxiety and stress was obtained for all 3 components of DASS 21 scale.

Table 1: results of WHOQOL BREF domains.

WHOQOL BREF DOMAINS	Pre intervention measure (mean±SD)	Post intervention measure (mean±SD)	p value
Physical Domain	51.53±7.97	55.38±8.06	0.047
Psychological Domain	53±10.42	61.15±9.32	0.008
Social Domain	60±12.12	69.77±12.23	0.011
Environmental Domain	57.88±16.71	62.69±14.23	0.119

Table 2: results of DASS 21 components.

DASS 21 components	Pre intervention measure (mean±SD)	Post intervention measure (mean±SD)	p value
Depression	12.18±8.38	9.85±7.50	0.039
Anxiety	16.35±9.75	9.85±7.72	0.001
Stress	16.82±5.83	9.23±4.87	0.001

DISCUSSION

The current study illustrates the effect of Virtual Reality Training on psychosocial factors in spinal cord injury patients and whether any benefits were reported afterwards.

In a recent study done by Post MW et al, it has been reported that people with spinal cord injury experience on an average

higher levels of distress and lower levels of life satisfaction than general population, the onset of which has been linked to the presence of an existing physical disability. ⁽¹⁷⁾ Also in a previous study by A R Craig et al, it was reported that spinal cord injury patients with permanent neurological loss deal with various stresses of coping with environmental and architectural barriers,

high economic costs, vocational limitations, strains on personal and social relationships on a daily basis. ⁽¹⁸⁾ This in turn leads to tremendous psychological upset causing high levels of depression and anxiety. Researches done in the past on studies in psychoneuroimmunology and psychoneuro-endocrinology have documented the existence of mechanisms by which negative-affect states, and the experience which caused them, can translate into pathogenic process and can hence hamper recovery. Hence “recovery disappointment” may act through mind-body pathways which lead to less than optimal outcomes of the recovery process. ⁽¹⁹⁾

Flores A et al in a study mentioned that, lack of mobility seen in paralyzed patients limits sensory stimulation. ⁽²⁰⁾ Physical therapy in spinal cord injury is a continuous process and hence patients’ motivation and participation in the rehabilitation process is of utmost importance in achieving faster recovery. Virtual reality training using games leads to increase patient participation and involvement in rehabilitation process. In a previous study done by Riva G, similar results were found with spinal cord injury patients responding to virtual reality based rehabilitation with an improved mood. ⁽²¹⁾ Multiple studies demonstrate that there are mood benefits of exercise in healthy individuals when combined with virtual reality based training.

The current study shows changes in the depression, anxiety and stress components of DASS 21 post virtual reality training sessions. Also, changes in the physical, social and psychological domains of WHOQOL BREF have been reported. Significant changes by the participants in the perception of their quality of life and health satisfaction were reported. No changes were observed in the environmental domain of the WHOQOL BREF as the domain consisted of questions related to the physical environment around the patients which is not in the scope of virtual reality training. Positive changes seen in the above

components were possibly due to change from monotonous therapy environment and equipments to fun virtual reality environment and games, leading to more patient participation, thus providing a confidence boost to the patient. Plante TG et al in a study deduced that exercises incorporating virtual reality games may further enhance the mood benefits of exercises and assist in participants feeling less anxious and tensed and more calm possibly because they did not feel as though they were participating in a physical therapy session and enjoyed the competitive virtual reality environment. ⁽²²⁾

The results of this study help us infer that virtual reality training stimulates motivation, interaction and excitement amongst the participants that are normally lacking in traditional equipments of therapy.

Furthermore, it was observed by the authors in this study that the participants were found to look forward to the virtual reality training session which would happen after the conventional rehabilitation session, leading to improved willingness and performance in the conventional therapy session. The participants enjoyed virtual reality based training sessions as they considered it fun games and not just therapy. It was observed that the participants got better at playing the games with each successive session. This helped them self evaluate their progress after every session and in turn helped build up more willingness and compliance towards the therapy and a major confidence boost in their own abilities.

Limitations of the study were that the sample size of the study was small due to time constrain. The study being a quasi experimental study has an absence of control group which limits conclusions. Future scope of the study includes that this study can be done in any other population with affected psychosocial factors. Virtual reality training can also be used to improve trunk balance, upper limb function, reaction time and hand eye coordination.

CONCLUSION

This study concludes that virtual reality training holds great potential to be a therapeutic tool in improving psychosocial factors in spinal cord injury patients. Virtual reality based rehabilitation gives a different approach to the treatment and also leads to more patient involvement in the rehabilitation process.

In addition to the acceptance of virtual reality based therapy, participants showed significant changes in the psychosocial factors and improved emotional state after their VR sessions. These findings are encouraging given the brief period of intervention used. Clinical implications of the study are that psychosocial factors profoundly affect patients' ability to recover. Virtual reality training is an effective and fun tool to improve psychosocial factors of the patients. It also helps to break the monotonicity of conventional therapy and leads to increased patient participation in the therapy session and rehabilitation process and hence can help achieving better recovery outcomes.

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