

Effect of virtual reality aided physical therapy in adjunct to traditional therapy in frozen shoulder patients

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ABSTRACT

Adhesive capsulitis causes discomfort, limited mobility, and joint stiffness. Various conservative physiotherapy management are used in frozen shoulder patients. Previously, patients were mostly treated with various heating modalities, mobilization techniques and exercises of shoulder. Virtual reality, on the other hand, may now be utilized to cure patients. In this study, traditional therapy, which includes Maitland's mobilization, is compared to virtual reality headset guided physiotherapy in addition to Maitland's mobilization. To compare the efficacy of virtual reality headset assisted physiotherapy to traditional physical therapy in frozen shoulder patients. A total of 50 male and female patients of 40-60 years are selected randomly. They were split into two groups of 25 patients each, in which one group had received traditional treatment of Maitland's mobilization and other group received virtual reality guided physical therapy with Maitland's mobilization. The above interventions were given for 2 weeks with 15-20 minutes of each session daily. The Numerical Pain Rating Scale (NPRS), Shoulder Range of Motion (ROM) using goniometry, and the Shoulder Pain Disability Index (SPADI) scale were used to examine the patient before and after the intervention. The chi-square test, as well as the student's paired and unpaired t tests, were used to examine the data. In patients with frozen shoulder, virtual reality headset i.e., oculus assisted physical therapy is more beneficial than traditional physical therapy, according to the findings of this study.

Keywords: Frozen shoulder, Maitland's mobilization, Oculus guided physical therapy, Range of motion.

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INTRODUCTION

Frozen shoulder is a painful condition that manifests itself as an inflammation, stiffness and restricted motion around the shoulder joint^{[1][2]}. Patients typically complain of shoulder discomfort that worsens with time and leads to a loss of mobility. Flexion, abduction, external and internal rotation are the four most prevalent limits in range of motion.

The prevalence rate has been estimated to be between 2 and 5.3 percent, with the majority of those affected being between the ages of 40 and 70 and usually 70 %females are more commonly affected^{[3][4]}. Normally, this illness is self-limiting and resolves in 2-3 years, although it can last up to 40 years in up to 40% of patients^[2].

According to previous studies, 20% patients with diabetes are affected by adhesive capsulitis compared to 3-5% of normal population^[3]. The presence of adhesive capsulitis in one side of shoulder increases the chances of involvement of opposite shoulder by 5-34 %^[4]. Symptoms of adhesive capsulitis may appear 6 years after the disease has started in many patients.^[5]

There are various operative and non-operative procedures are present for treatment of frozen shoulder patients. However, it is yet to confirm that which treatment is more effective. Early coordinated physiotherapy, manipulation under anesthesia (MUA), and surgical capsular release have all been compared clinically and cost-effectively in the past^[5].

Adhesive capsulitis is primarily managed with conservative treatment. Various surgical treatment can be acclimated secondarily for treatment of adhesive capsulitis. Medications such as corticosteroids and NSAIDS are used for pain relieving purpose. Physical therapy including heating modalities and manipulations can be used in frozen shoulder patients. The use of medications such NSAIDS and corticosteroids with physical therapy manipulations are successful in treatment of frozen shoulder. Physical therapy treatment has resulted in a considerable increase in the joint movement of the shoulder^[6,7].

The main aim of treatment is to reduce discomfort, recover,

and regain range of motion. Heating modalities with exercises can be helpful in treatment of frozen shoulder patients. The mobilization exercises of shoulder including pendulum exercises, passive and active assisted movement can be performed with application of moist heat. Stretching can also be added in treatment. Strengthening exercises such as isometrics can be performed in later stages of frozen shoulder^[1,2,6].

During management of frozen shoulder patient, initially it is managed with conservative treatment. Physiotherapy plays an significant role in conservative management but there are as such no evidences are present^[8]. Various heating modalities can be used for relieving pain which includes ultrasound, short wave diathermy, interferential therapy, hydro collateral packs etc. With these modalities, shoulder movements can be performed^[9]. Passive movements, active assisted movements, active movements, pendulum exercises can be performed to improve restricted ranges of shoulder joint.

Mobilization of the shoulder joint, in addition to conservative therapy, is beneficial in people with adhesive capsulitis^[2]. For improving ranges stretching of joint capsules by manual mobilizations are effective^[10]. The Maitland concept is described by the World Maitland Teachers Association (IMTA), as a method of evaluation, diagnosis, and management of Musculoskeletal illnesses using manual physical therapy. Maitland mobilization grade 1 and 2 are basically used to treat pain whereas grade 3 and 4 are used to stretch the capsule^[4,10]. Little amplitude oscillatory motion at the start of range of motion is the first grade of Maitland mobilization, whereas big amplitude oscillatory motion within accessible range is the second grade. Grade 3 oscillations have huge amplitudes at the end of range of motion, whereas grade 4 oscillations have tiny amplitude rhythmic oscillations at the end of range of motion, reducing tissue resistance. Grade 5 thrust movements are conducted at the end range with a short amplitude^[11]. Previous studies states that Maitland mobilization shows significant improvement in adhesive capsulitis patients^[2,10].

Virtual reality, on the other hand, is currently playing an essential part in the rehabilitation of sufferers suffering from a variety of conditions^[12]. Virtual reality is a three-dimensional virtual world created using advanced technologies. Currently virtual reality is used as device in rehabilitation of patients with various illnesses. Three headsets of virtual reality, the Oculus Rift, PlayStation VR, HTC Vive, drew a lot of interest at CES 2016. Virtual reality is a motivational method of achieving rehabilitative outcomes via the use of actual input and adaptive capacity with varying degrees of intensity.

The Oculus Rift is modern PC-based VR gaming headsets. Hand Physics Lab on Oculus Quest is a program that allows participants to use their hands and fingers to interact with a virtual

environment as well as other goods and experiences. Various shoulder movements such as shoulder internal and external rotations can be performed with the help of this games. Shoulder extensions flexion activities can also be carried out with the help of virtual reality games. This various gaming on virtual reality are useful for improving range of motion of joint.

According to previous researchers, In children with upper obstetrics brachial palsy, virtual reality in addition to traditional therapy by use of mirror is more significant treatment than conventional mirror therapy for improving hand functions and gripping. In patients affected with stroke, virtual reality in addition to task-oriented activities shows significant improvement in their performance of physical activitie.

However, no researches had performed on frozen shoulder patents till date on the advantages of oculus assisted physiotherapy. As a result, the goal of this study is to see how successful oculus aided physiotherapy is as a supplement to traditional therapy in adhesive capsulitis patients.

METHODOLOGY

This comparative study was carried out in the Musculoskeletal OPD of Acharya, Vinoba Bhave Rural Hospital, Sawangi (Meghe), Wardha, after receiving permission from the institutional ethical committee. Total sample size is 50, which includes two group of patients Group A and Group B, each group consists of 25 participants each with Frozen shoulder condition.

Inclusion Criteria: Patients between the age group of 40-60 years involving both genders and having stage 2 or stage 3 primary or idiopathic frozen shoulder.

Exclusion Criteria: Patients with any post-operative history of shoulder joint, fractures, subluxations or dislocations, diabetes, rheumatoid arthritis etc.

Group A: Conventional therapy, including Maitland's mobilization, was used as intervention.

Group B: Interventions was virtual reality (oculus) aided physical therapy and Maitland's mobilization.

Procedure

A strategy of randomized sampling was used. Two groups of patients were formed each of 25, using a simple random procedure (envelope method.) In this experiment, 25 envelopes were designated as Group A and 25 envelopes were designated as Group B, and the two envelopes were combined. Group A patients were treated with conventional therapy which included Maitland's mobilization whereas Group B patients were treated with Oculus guided physical therapy in addition to Maitland's mobilization. The envelopes were kept at registration counter and patients were selected randomly.

Statistical Analysis

Statistical analysis was performed using descriptive and inferential

statistics, including the chi-square test, student's paired and unpaired t test, and SPSS 27.0 version and GraphPad Prism 7.0 version software, with a significance level of 0.05.

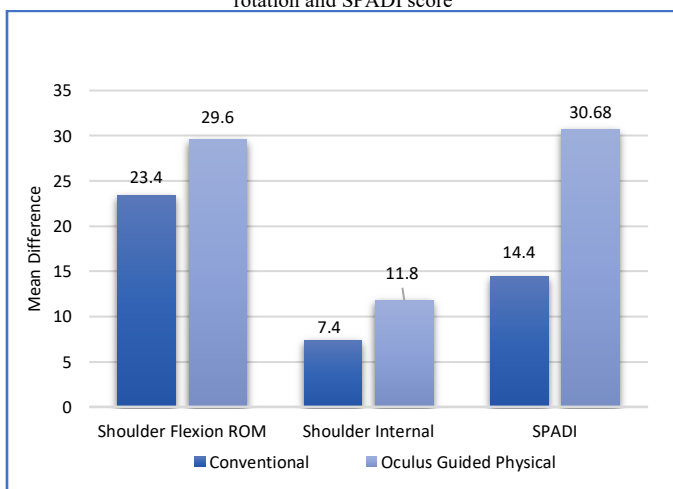
RESULTS

The results of this study demonstrated a significant improvement in shoulder joint Movement and reduction in pain when assessed with Numerical Pain Rating Scale (NPRS) and improvement in Shoulder Pain and Disability Index Scale (SPADI). Physical therapy using oculus shows more refinement in reducing pain and improving shoulder movement than traditional therapy.

Table 1: Comparison of mean difference of NPRS, shoulder flexion, extension, abduction, adduction, internal and external rotation.

Comparison in Two Groups at Pre and Post-Test For	Therapy	N0. Of patients	Mean difference	Std. Deviation	Std. Error Mean	t-value
NPRS	Conventional therapy	25	2.52	0.5	0.1	7.23 P=0.0001, S
	Oculus Guided Physical therapy	25	3.56	0.5	0.1	
Shoulder Flexion ROM	Conventional therapy	25	23.4	8	1.6	2.59 P=0.013, S
	Oculus Guided Physical therapy	25	29.6	8.88	1.77	
Shoulder Extension	Conventional therapy	25	6.8	3.78	0.75	3.17 P=0.003, S
	Oculus Guided Physical therapy	25	9.92	3.12	0.62	
Shoulder Abduction	Conventional therapy	25	20.2	10.04	2	4.84 P=0.0001, S
	Oculus Guided Physical therapy	25	34	10.1	2.02	
Shoulder Adduction	Conventional therapy	25	6.4	3.06	0.61	4.27 P=0.0001, S
	Oculus Guided Physical therapy	25	9.48	1.89	0.37	
Shoulder Internal	Conventional therapy	25	7.4	2.92	0.58	5.38 P=0.0001, S
	Oculus Guided Physical therapy	25	11.8	2.84	0.56	
Shoulder External	Conventional therapy	25	11	3.22	0.64	2.13 P=0.038, S
	Oculus Guided Physical therapy	25	12.84	2.86	0.57	
SPADI	Conventional therapy	25	14.4	2.93	0.58	5.28 P=0.0001, S
	Oculus Guided Physical therapy	25	30.68	15.07	3.01	

Figure 1: Comparison of mean difference of shoulder flexion, internal rotation and SPADI score



DISCUSSION

Adhesive capsulitis is another name for frozen shoulder, is an inflammatory disorder of the shoulder joint. It consists of three stages as freezing stage, frozen stage and resolution stage. In order to reduce the symptoms of frozen shoulder, physiotherapeutic management can be administered to the patient. This study shows comparison of traditional methods with virtual reality for treatment of

frozen shoulder. Traditional methods i.e., conventional therapy includes grade 3 and grade 4 of Maitland's mobilization.

Virtual reality is currently frequently employed in the rehabilitation of individuals suffering from a wide range of illnesses. In this study, Oculus guided physical therapy is given to the patients in addition to traditional therapy i.e., Maitland's mobilization. Oculus is a part of virtual reality, which visualizes three dimensional or realistic environment while performing any activity. This study included oculus guided physical therapy by use of Hand Physics Lab on Oculus Quest game. During playing of this game, various shoulder movements can be performed.

This study included comparison between two groups of frozen shoulder patients, in which one group was treated with conventional therapy and other with oculus guided physical therapy. The measures of the end result of this study were Numerical Pain Rating Scale (NPRS), Shoulder Range of Motion (ROM), Shoulder Pain and Disability Index (SPADI) scale. According to this outcome measures, this study results were compared between two groups.

The first dimension of this study was Numerical Pain Rating Scale (NPRS). The mean score of NPRS of conventional therapy and oculus guided physical therapy shows significant improvement at post-test, which shows this relationship is statistically significant. The mean difference of NPRS score of oculus guided physiotherapy indicates more remarkable refinement in reducing pain as compared to conventional therapy ($t=7.23$, $P=0.0001$). The mean score of shoulder flexion in conventional therapy and oculus guided physical therapy denotes significant improvement of shoulder flexion range at post, this correlation shows statistically significant. ($t=2.59$, $P=0.013$)

The shoulder extension is other parameter of this study, in which mean score of conventional and oculus guided physical therapy group at post score shows significant improvement, this indicates

statistically significant relationship. After intervention of oculus guided physical therapy there is more significant improvement in shoulder extension as compared to conventional therapy group. ($t=3.17$, $P=0.003$)

In shoulder abduction, mean score of conventional and oculus guided physical therapy shows significant improvement at post-test. But as compared to conventional therapy, oculus guided physical therapy shows more significant improvement in abduction of shoulder with frozen shoulder patients. ($t=4.84$, $P=0.0001$)

In shoulder adduction, post-test score of conventional and oculus guided physical therapy shows notable improvement. In oculus guided physical therapy, there is remarkable improvement in shoulder adduction range of motion as compared to conventional therapy. ($t=4.27$, $P=0.0001$)

In shoulder internal rotation, post-test mean score of conventional and oculus guided physical therapy is more which indicates statistically significant improvement. On comparing two groups, interventions of oculus guided physical therapy shows more remarkable improvement in range of shoulder internal rotation. ($t=5.38$, $P=0.0001$) The mean of SPADI score in conventional therapy and oculus guided physical therapy at post-test is more, which indicates statistically significant improvement. As compared to conventional therapy, oculus guided physical therapy group shows more remarkable improvement in SPADI score. ($t=5.28$, $P=0.0001$)

This study shows that there is significant improvement in patients of frozen shoulder for pain, range of motion and Shoulder Pain and Disability Index (SPADI). After comparing the results of outcome measures, study shows more significant improvement in patients treated with oculus guided physical therapy. Abdullah Al Shehri et al study was conducted on frozen shoulder patients; one group of patients were treated with Maitland's mobilization and other group with ultrasound. In this study, for reduction of pain and improvement of ROM, patients treated with Maitland's mobilization shows more significant improvement^[2].

The study of Kumar A, Kumar S, consists of two group of patients of frozen shoulder, one group of patients was treated with Maitland's mobilization and shoulder ROM exercises while other group was treated with only supervised shoulder exercises. After comparing two groups, patients treated with mobilization along with exercises shows more refinement in movements of shoulder and for reducing pain^[10].

In the present study, both the study groups show significant improvement for reducing symptoms of frozen shoulder. Patients treated with oculus guided physical therapy shows more remarkable improvement in reducing symptoms of frozen shoulder as compared to conventional therapy intervention.

CONCLUSION

Our study is mainly focused on adhesive capsulitis patients. The goal of this research is to decrease discomfort and increase range of motion. In conventional therapy, Maitland's mobilization technique with grade 3 and grade 4 was used. The Hand Physics Lab on Oculus Quest game was used in oculus guided physical therapy in addition to Maitland's mobilization. After comparing the results of two study groups, patients treated with interventions of oculus guided physical therapy shows more remarkable improvement in reducing pain, improving movement of shoulder and for shoulder related activities of daily living.

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