Effect of game based virtual reality training versus conventional physiotherapy in periarthritis shoulder

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ABSTRACT

BACKGROUND: Periarthritis shoulder is the chronic condition characterized by stiffness and pain in shoulder with a limited range of active and passive motion in all the directions. Periarthritis shoulder can be treated using joint mobilization and by Conventional therapy which consist of different stages to control pain, improve flexibility and range of motion but virtual reality is different from traditional intervention and it is not much practiced in clinical setting for orthopedic conditions.

AIM: The aim of the study is to determine the effect of Game based Virtual Reality training versus conventional Physiotherapy in Periarthritis Shoulder.

METHODS: This study was conducted in NIEPMD and were recruited and they were conveniently divided into Group A (experimental group) received 40 mins of Game based virtual reality training using X-box Kinetic 360 wireless sensor and Group B (Control group) received 40 mins of conventional physiotherapy. The outcome measures used were NPRS and SPADI

Result: the results were analysed using paired and independent t test. The pre and post test values of both Experimental and Control group shows significant effect on pain, upper limb function and quality of life. The mean difference of both group compared shows significant effect in NPRS (p<0.05) and insignificant effect in SPADI and shoulder range of motions.

CONCLUSION: The 4 weeks program of Game based Virtual Reality training was equally effective in reducing pain and improving range of motion and upper limb function in people with Periarthritis shoulder.

KEY WORDS: Periarthritis, virtual reality, conventional Physiotherapy, functional Disability, ROM.

INTRODUCTION

Periarthritis shoulder is characterized by painful and restricted shoulder ROM in patients characterized by perivascular inflammation and fibroelastic proliferation[1,2]. It typically occurs in the fifth and sixth decades of life, thus affecting individuals of working age[3]. Periarthritis shoulder can be either primary (idiopathic) or secondary. Secondary periarthritis shoulder is defined as that associated with trauma; rotator cuff disease and impingement; cardiovascular disease; hemiparesis; or diabetes (although some classify this in diabetics as primary Periarthritis shoulder).

The incidence of Periarthritis shoulder in people with diabetes is reported to be 10% to 36%, and these tend not to respond as well to treatment as in non-diabetics[4,5]. In India, the prevalence of adhesive capsulitis is as high as 10% to 22% in diabetes mellitus as compared normal population which is 02% and 04%. Another study conducted with 135 patients says that 21 (15.5%) patients with idiopathic adhesive capsulitis of shoulder were found to be prediabetic, and 37 (27.4%) patients were found to be diabetic. However, 31 patients had family history of diabetes.

Periarthritis shoulder can be treated using joint mobilization, shoulder rehabilitation proper medications, and surgery. Conventional therapy consists of electrotherapy modalities like Wax therapy, IFT, US and exercises like stretching exercise Codman’s Exercise and pulley exercise, finger crawling and joint mobilization were given to control pain, improve flexibility and range of motion[7,8].

As there are many research supporting the rehabilitation of Periarthritis Shoulder one main struggle faced by therapist is motivating the patient throughout the conventional training. Virtual reality gaming is newly used method and increases motivation of the subject and participation to exercise better than conventional therapy[9]. It is three- Dimensional and computer-aided program which is built with a system that creates virtual movements and provides high level of visual and sensory feedback during the exercise[9].

In recent years, because of the advancement in technology many researchers here employed virtual reality technology in rehabilitation therapies which shows the feasibility and usability of proposed VR system combining the technology with task design elements that appeal of rehabilitation treatments which increases patient motivation and maximizes the therapeutic effect indicating the effectiveness of VR based Rehabilitation[10]. This study used VR based interactive shoulder rehabilitation system that enables patients diagnosed with Periarthritis Shoulder to perform movements such as flexion, abduction, internal rotation and external rotation and circumduction[11]. They also showed that movements learned in a VR environment are transferable to real-world similar motor tasks. It facilitates the calibration at joints orientation, passion of the leading joints and muscle activities throughout the game play. These are 3 primary categories of virtual reality stimulation used today non-immersive, semi-immersive and fully immersive stimulations. Non immersive VR is technology that provides users with a computer-generated environment with feeling being immersed in the virtual world. The characteristic of non-immersive VR system is that users can keep control over Physical surrounding while being aware of what’s going around them sounds, virtual and haptics[21]. As Virtual reality is most commonly used in neurological conditions like stroke, Cerebral Palsy only few studies were done using virtual reality training for Orthopedic conditions. So, this study attempts to find out the effect of Game based Virtual reality training on pain, upper limb function and Range of motion.

AIM OF THE STUDY
The aim of the study is to find out the effect of Game based Virtual Reality training versus conventional Physiotherapy in Periarthritis Shoulder.

OBJECTIVES OF THE STUDY

The primary objective of the study is to find out the effect of Game based Virtual Reality training on pain and upper limb function. The secondary objective of the study is to find out the effect of Game based Virtual Reality Training for improving Range of Motion and disabilities in individuals with Periarthritis Shoulder.

METHODOLOGY

<table>
<thead>
<tr>
<th>Study Type</th>
<th>Quasi Experimental Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study Design</td>
<td>Comparative Study</td>
</tr>
<tr>
<td>Sampling Method</td>
<td>Convenient Sampling</td>
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<tr>
<td>Sample Size</td>
<td>30</td>
</tr>
<tr>
<td>Duration Of the Study</td>
<td>4 Weeks</td>
</tr>
<tr>
<td>Study Setting</td>
<td>NIEPMD, ECR, Muttukadu, Chennai.</td>
</tr>
</tbody>
</table>

INCLUSION CRITERIA

- Age Group of 45 And Above
- Both Male and Female
- Periarthritis Shoulder – stage 2
- Pain and restriction range of motion more than 3 months.

EXCLUSION CRITERIA

- Patient Undergone Recent Surgeries
- Any Other Associate Problems Like Bone Infection, Neurological Problems, Psychiatric Disorders
- Shoulder Dislocation
- Any Visual and Hearing Impairments
- Post-Surgical Stiffness/Trauma
- Rheumatoid Arthritis
- Fracture
- Shoulder impingement syndrome.

MATERIALS USED

- X-Box kinetic 360
- TV/Monitor
- Goniometer
- IFT (Interferential Therapy)
- Informed consent form

Fig 1: X-box Kinetic with TV

OUTCOME MEASURES

- SPADI scale (Shoulder Pain and Disability Index).
- NPRS Scale (Numerical Pain Rating Scale).
PROCEDURE

This study conducted at NIEPMD, ECR, Chennai, a total of 30 participants were selected for this study. Participants were instructed all details about the study and informed consent form was signed. All participants were divided in to two groups by convenient sampling method, Group A (experimental) – 15 and Group B (control) – 15. Before the first session of treatment for the individuals, Pre- test values of Shoulder Pain and Disability Index [SPADI], Range of Motion and Numerical Pain Rating Scale[NPRS]were assessed. Both group participants were received IFT for 10mins.

GROUP A (experimental group) received 40 mins of Game based virtual reality training using X-box Kinect 360 wireless sensor focusing on flexion, abduction and medial and lateral rotation of the shoulder. The games like climbing, bowling pin bowling, tennis and Gun shooting , ship wheel were included.

GROUP B (Control group) received 40 mins of conventional therapy capsular stretching exercise, Codman’s Exercise, towel stretch, wand exercise, cog wheel exercise,pulley exercise, finger ladder exercise and elastic band exercise.

Both Group A and Group B received the treatment for about 50 minutes of 1 session per day, 3 days in a week for 4 weeks.

GROUP A participants were treated by performing game based Virtual reality training using x-box Kinect 360 wireless sensor focusing on flexion, abduction, medial and lateral rotation of the shoulder.
✓ The participants playing the x-box Kinect games, these sessions consisted of playing five different games from Kinect adventure series.
✓ This game uses Microsoft Kinect, a motion sensing input device that tracks user movements therefore players have to move their arms in a specific way to perform the necessary manipulations in the game.
✓ The games like climbing, bowling, pin bowling , tennis, gun shooting and ship steer wheels.
✓ The therapy consisted of a series of immersive games Kinect adventure designed for x-box 360 Kinect console.

The games were projected into screen.
✓ The virtual reality system also allows therapist to monitor patient progress in the game can check the number of points gained by player.
✓ All games were played at the basic level on initials trial day the participants were asked to complete one round of each game as an introduction.
✓ The participants were instructed to obtain as many points awarded as possible. Scores were documented as a baseline during initial trial round verbal instructions and explanations of the game was given prior to starting.
✓ This training included instruction on upper extremity movements which are components needed to be successful in each of the games.
✓ A therapist was standing near to the participant while they were playing games and preventing him from losing balance as a result of excessive body shift.

GROUP B received 40 minutes conventional therapy capsular stretching exercise, Codman's exercise, Towel stretch, pulley, wand exercises, cog wheel exercise, finger ladder and active range of motion and elastic band exercises for shoulder.

Anterior capsular stretching: Standing in a door way ,near a post or etc., with elbow straight arm abducted to 90-degree ,grip object with hand. Placing gentle pressure forward to create a gentle stretch to the front of the shoulder .Hold for 5-8 stretch.

Posterior capsular stretching: Making the patient in standing or sitting position, bring them. elbow across the body horizontally. Hold the stretch with your opposite hand placed at the elbow .Hold the stretch for 15 sec and repeat 10 times . Feel the comfortable stretch at the back of the shoulder joint.

Inferior capsular stretching: Hold arm overhead with elbow bent and arm straight ahead using opposite arm stretch arm further overhead. Bring arm to point where gentle stretching sensation is felt. Hold for 5-8 seconds repeat 2-4 times.

Pendular exercises: Asking them to relax their shoulders. Stand and lean over slightly, allowing the affected arm to hang down. Swing the arm in a small circle — about a foot in diameter.10 revolutions in each direction, once a day. As symptoms improve, increase the diameter of swing, but never force it. When they are ready for more, increase the stretch by holding a light weight (three to five pounds) in the swinging arm.

Towel stretch exercise: Hold one end of a three-foot-long towel behind the back and grab the opposite end with the other hand. Hold the towel in a horizontal position. Use unaffected arm to pull the affected arm upward to stretch it. Can also do an advanced version of this exercise with the towel draped over your good shoulder. Holding the bottom of the towel with the affected arm and pull it toward the lower back with the unaffected arm. 10 to 20 times a day.

Finger ladder exercises: Face a wall three-quarters of an arm's length away. Reach out and touch the wall at waist level with the fingertips of the affected arm. With their elbow slightly bent, slowly walk fingers up the wall, spider-like, until they raised arm as far as they comfortably can. Fingers should be doing the work, not shoulder muscles. Slowly lower the arm (with the help of the good arm, if necessary) and repeat. 10 to 20 times a day.

Elastic band exercises-

Lateral rotation: Holding a rubber exercise band between the hands with elbows at a 90-degree angle close to their sides. Rotate the lower part of the affected arm outward two or three inches and hold for five seconds.

Medial rotation: Stand next to a closed door, and hook one end of a rubber exercise band around the doorknob. Holding the other
end with the hand of the affected arm, holding the elbow at a 90-degree angle. Pull the band toward their body two or three inches and hold for five seconds. Repeat 10 to 15 times, once a day. Pulley, wand exercises, cog wheel exercise, active range of motion exercises alternative days for 4 weeks.

**GROUP 1 TREATED WITH GAME BASED VIRTUAL REALITY TRAINING**

**GROUP 2 TREATED WITH CONVENTIONAL PHYSIOTHERAPY**
DATA ANALYSIS

Statistical analysis was done using SPSS 20. From the given data, it passes the normality, so the t-test has done. Paired sample t test was used to find out the effect within experimental group 1 (Game based Virtual Reality training) and control group 2 (Conventional physiotherapy). Independent t test was used to find out the effect between experimental group 1 (Game based Virtual Reality training) and control group 2 (Conventional physiotherapy).
Summary of baseline characteristics:

<table>
<thead>
<tr>
<th>MEAN AGE</th>
<th>GENDER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Game Based Virtual Reality</td>
<td>Conventional Physiotherapy</td>
</tr>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>54 ± 6.425</td>
<td>64 ± 5.551</td>
</tr>
</tbody>
</table>

Table 2: Shows pre and post mean values of Group-A SPADI

This table shows that there was significant improvement in SPADI within Experimental group 1 treated with game based virtual reality training (p < 0.05*).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t-VALUE</th>
<th>P- VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRE-TEST</td>
<td>POST-TEST</td>
<td>PRE-TEST</td>
<td>POST-TEST</td>
</tr>
<tr>
<td>SPADI</td>
<td>73.3940</td>
<td>45.8247</td>
<td>8.517</td>
<td>6.247</td>
</tr>
</tbody>
</table>

P <0.05*  

GRAPH 1
TABLE 3: Shows pre and post mean NPRS value of GROUP-A

This table shows that there was significant improvement in NPRS within Experimental group 1 treated with Game based Virtual Reality Training (p < 0.05*).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t- VALUE</th>
<th>P- VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRE-TEST</td>
<td>POST TEST</td>
<td>PRE-TEST</td>
<td>POST TEST</td>
</tr>
<tr>
<td>NPRS</td>
<td>6.93</td>
<td>4.20</td>
<td>0.772</td>
<td>0.909</td>
</tr>
</tbody>
</table>

GRAPH 2

Table 4: Shows pre and post mean values of Group-A shoulder Range of motion

This table shows that there was significant improvement in Shoulder Flexion, Abduction, External Rotation and Internal Rotation Range of Motion within Experimental group 1 treated with Game based Virtual Reality Training (p < 0.05*)
### Table 5: Shows pre and post values of Group B SPADI

This table shows that there was significant improvement in SPADI within Experimental group 2 treated with Conventional Physiotherapy ($p < 0.05^*$).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t-VALUE</th>
<th>P- VALUE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Pre test</td>
<td>Post test</td>
<td>Pre test</td>
<td>Post test</td>
</tr>
<tr>
<td>Shoulder Flexion</td>
<td>109.33</td>
<td>134.33</td>
<td>11.671</td>
<td>10.467</td>
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<tr>
<td>Shoulder Abduction</td>
<td>88.33</td>
<td>112.00</td>
<td>16.499</td>
<td>12.356</td>
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<tr>
<td>Shoulder External Rotation</td>
<td>40.33</td>
<td>56.33</td>
<td>5.907</td>
<td>7.180</td>
</tr>
<tr>
<td>Shoulder Internal Rotation</td>
<td>57.333</td>
<td>70.333</td>
<td>9.638</td>
<td>6.700</td>
</tr>
</tbody>
</table>

$P <0.05^*$  \hspace{1cm} $P >0.05^{**}$

### Table 6: Shows pre and post mean values of Group-B NPRS

This table shows that there was significant improvement in NPRS within Experimental group 2 treated with Conventional Physiotherapy ($p < 0.05^*$).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t-VALUE</th>
<th>P- VALUE</th>
</tr>
</thead>
<tbody>
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<td>Pre-test</td>
<td>Post-test</td>
<td>Pre-test</td>
<td>Post-test</td>
</tr>
<tr>
<td>SPADI</td>
<td>79.976</td>
<td>50.0707</td>
<td>7.126</td>
<td>6.085</td>
</tr>
</tbody>
</table>

$P <0.05^*$  \hspace{1cm} $P >0.05^{**}$

**GRAPH 4**

![Graph showing pre and post test SPADI values](image-url)
Table 7: Shows pre and post values of Group B Range of motion
This table shows that there was significant improvement in shoulder flexion, abduction, external rotation and internal rotation range of motion within experimental group treated with conventional physiotherapy (p < 0.05*).

<table>
<thead>
<tr>
<th>PARAMETER</th>
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<th>STANDARD DEVIATION</th>
<th>t- VALUE</th>
<th>P- VALUE</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>PRE-TEST</td>
<td>POST TEST</td>
<td>PRE-TEST</td>
<td>POST TEST</td>
</tr>
<tr>
<td>NPRS</td>
<td>7.07</td>
<td>5.07</td>
<td>0.680</td>
<td>0.854</td>
</tr>
</tbody>
</table>

P <0.05*  P >0.05**

GRAPH 5

Table 7: Shows pre and post values of Group B Range of motion
This table shows that there was significant improvement in shoulder flexion, abduction, external rotation and internal rotation range of motion within experimental group treated with conventional physiotherapy (p < 0.05*).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t- VALUE</th>
<th>P- VALUE</th>
</tr>
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<tbody>
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<td></td>
<td>PRE-test</td>
<td>Post test</td>
<td>PRE-test</td>
<td>Post test</td>
</tr>
<tr>
<td>Shoulder Flexion</td>
<td>109.67</td>
<td>133.33</td>
<td>15.542</td>
<td>17.288</td>
</tr>
<tr>
<td>Shoulder Abduction</td>
<td>84.67</td>
<td>109.00</td>
<td>14.772</td>
<td>12.410</td>
</tr>
<tr>
<td>Shoulder External Rotation</td>
<td>41.00</td>
<td>59.00</td>
<td>7.348</td>
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<tr>
<td>Shoulder Internal Rotation</td>
<td>56.333</td>
<td>71.666</td>
<td>9.214</td>
<td>7.674</td>
</tr>
</tbody>
</table>

P <0.05*  P >0.05**
Table 8: Shows post values of GROUP A AND B SPADI
This table shows that there was no significant improvement in SPADI (p >0.05**) between group 1 (treated with game based virtual reality training) and group 2 (treated with conventional physiotherapy).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>POST MEAN</th>
<th>STANDARD DEVIATION</th>
<th>t- VALUE</th>
<th>P- VALUE</th>
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<td></td>
<td>Virtual Reality</td>
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<td>Virtual Reality</td>
<td>Conventional Physiotherapy</td>
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<tr>
<td>SPADI</td>
<td>27.261</td>
<td>29.972</td>
<td>4.580</td>
<td>6.470</td>
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</tbody>
</table>

P <0.05*  P >0.05**

Table 9: Shows post values of GROUP A AND B NPRS
This table shows that there was significant improvement in NPRS (p < 0.05*) between group 1 (treated with game based virtual reality training) and group 2 (treated with conventional physiotherapy).
reality training) and group 2 (treated with conventional physiotherapy).

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>POST MEAN</th>
<th>STANDARD DEVIATION</th>
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<th>P- VALUE</th>
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<td>Virtual Reality</td>
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<tr>
<td>NPRS</td>
<td>2.00</td>
<td>0.756</td>
<td>2.73</td>
<td>0.704</td>
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</table>

**P <0.05**  **P >0.05**

**GRAPH 8**

Table 10: Shows post values of GROUP A AND B Shoulder Range of motion
This table shows that there was no significant improvement in shoulder flexion, abduction, external rotation and internal rotation range of motion (p >0.05**) between group 1 (treated with game based virtual reality training) and group 2 (treated with conventional physiotherapy).

<table>
<thead>
<tr>
<th>PARAMETER</th>
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<th>t- VALUE</th>
<th>P- VALUE</th>
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<td></td>
<td></td>
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<td>Conventional Physiotherapy</td>
<td>Virtual Reality</td>
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<td>5.000</td>
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<tr>
<td>Shoulder Abduction</td>
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<td>10.998</td>
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<tr>
<td>Shoulder External Rotation</td>
<td>16.00</td>
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</table>
Shoulder Internal Rotation

<table>
<thead>
<tr>
<th></th>
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<th>t-value</th>
<th>p-value</th>
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<tbody>
<tr>
<td>SPADI</td>
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<td>4.419</td>
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<tr>
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<tr>
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<tr>
<td>Shoulder Abduction</td>
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<td>Shoulder External Rotation</td>
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<tr>
<td>Shoulder Internal Rotation</td>
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</table>

P <0.005* P >0.005*

**RESULTS**

According to table 2, table 3 and table 4, the mean of post SPADI, NPRS, Shoulder flexion, Shoulder Abduction, Shoulder External Rotation and Shoulder Internal Rotation range of motion were improved while comparing with pre value and it was significant at p < 0.05 level in Game Based Virtual Reality training group which is less than table value. Hence null hypothesis rejected.

According to table 5, table 6 and table 7, the mean of post SPADI, NPRS, Shoulder flexion, Shoulder Abduction, Shoulder External Rotation and Shoulder Internal Rotation range of motion were improved while comparing with pre value and it was significant at p < 0.05 level in Conventional Physiotherapy group which is less than table value. Hence null hypothesis rejected.

On comparing the pre values of both group 1 and group 2, there were no difference between the groups. So both groups are comparable.

According to table 8 and table 10, the mean of both groups SPADI, NPRS, Shoulder flexion, Shoulder Abduction, Shoulder External Rotation and Shoulder Internal Rotation range of motion was not much improved while comparing between two groups and it was in significant at p > level between the group which is more than table value. Hence null hypothesis accepted for SPADI, Shoulder Flexion, Abduction and External rotation range of motion. According to table 9, the mean of both groups NPRS were...
improved while comparing between two groups and it was significant at p <0.05 level between the group which is less than table value. Hence, Alternative Hypothesis was accepted. In graph 1, graph 2 and graph 3, the pre-test and post-test values of SPADI, NPRS, Shoulder flexion, Abduction, External Rotation and Shoulder Internal Rotation range of motion of group 1 were compared which shows a significant difference within the group. In graph 4, graph 5 and graph 6, the pre-test and post-test values of SPADI, NPRS, Shoulder flexion, Abduction, External Rotation and Shoulder Internal Rotation range of motion of group 2 were compared which shows a significant difference within the group.

In graph 7, graph 8 and graph 9, the post-test values of SPADI, Shoulder flexion, Abduction, External Rotation and Shoulder Internal Rotation range of motion were compared shows insignificant differences between group and NPRS shows significant differences between the groups.

**DISCUSSION**

This study was done to compare the effect of Game based Virtual Reality training and Conventional Physiotherapy in Periarthritis shoulder. The values of SPADI, NPRS, Shoulder flexion, Abduction, Internal Rotation and External Rotation range of motion were compared within both groups.

The result showed the significant effect in pain, range of motion and upper limb functions in both the groups (Game based Virtual Reality Training and Conventional Physiotherapy) indicating that two interventions were effective for reducing pain and improving range of motion and upper limb functions in the sample studied. However, on comparing the mean of pre and post values of SPADI, Shoulder Flexion, Abduction, Internal Rotation and External Rotation range of motion of these two groups, shows no significant effect and on comparing the mean of pre and post values of NPRS between these two groups, shows significant effect.

VR is a novel technology defined as “the use of interactive simulations created with computer hardware and software to present users with opportunities to engage in environments that appear to be and feel similar to real-world objects and events”[12,13]. In a VR system, the complexities of the real world are simulated in a controlled environment[12,14] and it is commonly used in many neurological conditions.

Many of the mechanisms underpinning the effect of VR in other populations may be applicable in managing musculoskeletal conditions. However, only limited studies were there using Virtual Reality training in the orthopedical or musculoskeletal rehabilitation. VR-based interventions for use in musculoskeletal conditions require careful design and development, feasibility testing, pilot testing and randomized controlled trials to determine efficacy[16].

Thomas et al.[17,19], demonstrated the feasibility of using a VR dodgeball game, which involved participants with low back pain bending and reaching to avoid contact with a virtual ball. Similarly, Hennessy et al[18,19] demonstrated that a VR application designed to facilitate graded exposure to everyday tasks for individuals with chronic back pain was safe and acceptable. As virtual reality in orthopedic rehabilitation is evolving now, this study is one among that to find the effect of virtual reality training in the Periarthritis shoulder. This study revealed that the post-test values of SPADI, NPRS, Shoulder flexion, Abduction, External Rotation and Internal Rotation range of motion were showed significant improvement (<0.05) than pre-test value in Game based Virtual Reality training. This study is lined with the study by Joanna Byra and Krzysztof Czernicki (2020) who done study to find out the effectiveness of Virtual Reality rehabilitation in patient with hip and knee osteoarthritis concluded that intervention based on virtual reality are the promising in view of pain management, range of motion and proprioception.

Similarly, the post-test value of SPADI, Shoulder flexion, Abduction, External Rotation and Internal Rotation range of motion where not significantly improved (p>0.05) when compared between Game based Virtual Reality Training and Conventional Physiotherapy. This study lined with Donny Gunawan et al., (2020) who concluded that Stretching exercises compared with virtual reality games exercises in Periarthritis Shoulder patients provided the same benefits of stretching with the Over Head Pulley on improvement.

Thus, Virtual Reality training and conventional physiotherapy are equally effective on shoulder range of motion and upper limb function and conventional Physiotherapy is more effective in reducing pain in individuals with Periarthritis shoulder. This study experience suggests that even though there is a pain in the initial stage of virtual reality training, motivation and involvement of the individual in the games gave good effect on pain, upper limb function and range of motion.

**CONCLUSION**

This study aimed to compare the effect of Game based Virtual Reality Training versus conventional physiotherapy in Periarthritis Shoulder. The result revealed that the mean value of SPADI, Shoulder flexion, abduction, External Rotation and Internal Rotation of Game based Virtual Reality training and Conventional Physiotherapy shows no significant effect and mean value of NPRS shows significant effect between two groups.

The present study concluded that 4 weeks program of Game based Virtual Reality training was equally effective in reducing pain and improving range of motion and upper limb function in people with Periarthritis shoulder. Thus, Game based Virtual Reality training combined with physiotherapy seems to be beneficial for people with Periarthritis shoulder for reducing pain and improving range of motion and functional disability.
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