



Pilates Exercise Versus Virtual Reality on Upper Limb Dysfunction Post Mastectomy

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Abstract

Background: Upper limb dysfunction following mastectomy is a prevalent problem that frequently occurs after breast cancer surgery. Approximately 67% of breast cancer patients encounter difficulties with their arm or shoulder, such as reduced strength, decreased ROM, along with functional limitations, after undergoing surgery.

Purpose: the study was carried to compare Pilates exercise versus virtual reality in improving upper limb dysfunction after mastectomy.

Methods: Sixty patients with upper limb dysfunction post Mastectomy got involved in this study. Their ages ranging between 35 and 55 years. they were randomly distributed into two equal groups. The methods of assessment included electronic hand dynamometer to assess hand grip strength, smartphone inclinometer to assess shoulder range of motion and Arabic version of The American Shoulder and Elbow Surgeons Evaluation Form to assess upper limb function. Group (A) received Pilates exercise plus conventional physical therapy program (Mobilization exercises and ROM exercises) as well as routine medical treatment. Group (B) received virtual reality plus conventional physical therapy program (Mobilization exercises and ROM exercises) as well as routine medical treatment.

Results: There was a significant improvement in shoulder flexion ROM, ASES as well as hand grip following treatment in both groups compared with that prior to treatment ($p < 0.001$). The percent of change in shoulder flexion, abduction and external rotation, ASES and hand grip of group A was 42.49, 35.49, 56.87, 76.09 and 14.45% respectively and that in group B was 21.83, 26.52, 35.62, 38.85 and 8.49% respectively

So The results showed that there was decrease in upper limb dysfunction in group A compared to group B, in relation to shoulder ROM, upper limb function and hand grip, There was a significant improvement in the flexion, abduction and external rotation ROM of shoulder, ASES, hand grip of group A compared with group B following treatment

Conclusion: it was concluded that Pilates exercise is superior to virtual reality in improving upper limb dysfunction

Key words: upper limb dysfunction, mastectomy, Pilates exercise, virtual reality.

INTRODUCTION:

Breast cancer is the most prevalent form of malignancy in women. Surgery is a common treatment for breast cancer in its advanced phases, provided that the tumour is localised. This treatment may be followed by chemotherapy, radiotherapy, or both. Mastectomy, quadrantectomy, as well as lumpectomy are the standard surgical procedures for breast cancer [1]. Mastectomy is a surgical procedure that involves the complete removal of the breast. The five distinct kinds of mastectomy include "simple" or "total" mastectomy, modified radical mastectomy, radical mastectomy, partial mastectomy, as well as subcutaneous (nipple-sparing) mastectomy [2].

The main types of mastectomies include standard mastectomy, which involves the removal of entire breast tissue and a significant portion of the skin that covers it. Skin sparing mastectomy involves the complete removal of breast tissue, including the nipple, while preserving a significant portion of the skin that covers the breast. Nipple-sparing mastectomy is a surgical procedure that involves removing the breast tissue while preserving the nipple. A radical mastectomy is a technique that involves the complete removal of all breast tissue, along with the skin covering it, the two muscles located behind the breast, along with the lymph nodes in the armpit. This procedure is now considered not common. Modified radical mastectomy refers to a surgical procedure where the larger of the two pectoral muscles, located behind the breast, is preserved while the rest of the breast tissue is removed. Usually, the operation includes eliminating the majority of the breast tissue, skin as well as the nipples [2]. Surgery in addition treatments for breast cancer can result in upper extremity impairments and functional restrictions, including pain, stiffness, lymphedema, cording, reduced strength along with ROM, as well as less activity tolerance. Patients who undergo mastectomy surgery sometimes have a longer recovery period with additional functional limitations compared to those who receive breast conservation therapy [3].

From surgery to six years post-surgery, women who have undergone breast cancer treatment frequently experience shoulder pain as well as diminished function. Approximately 10–55% of women exhibit restricted shoulder ROM, 22–38% experience shoulder pain, in addition 42–56% encounter challenges lifting their upper limbs or reaching above their heads. These symptoms are frequently enduring and significantly impair their quality of life along with their ability to return to work [4]. Pilates enhances flexibility, builds strength, as well as develops control along with endurance throughout the entire body. The practice emphasizes the importance of proper alignment, controlled breathing, strengthening the core muscles, and enhancing coordination and balance. The core, which comprises the abdominal, lower back, and hip muscles, is commonly referred to as the "powerhouse" and is believed to be crucial for an individual's stability [5].

The Pilates system offers the flexibility to adjust the difficulty level of exercises, ranging from beginner to advanced or any other desired level. The intensity of the exercises can be gradually raised as the body acclimates and adjusts. The six elements of Pilates are concentration, control, centre, flow, precision, as well as breathing [6]. Virtual reality (VR) therapy appears to be effective as conventional therapy in enhancing the functionality of the upper extremities and the performance of fundamental daily activities. These interventions are effective because patients concentrate on stimuli that are enjoyable or interesting, rather than on symptoms that are disagreeable and pertain to the emotional domain. Distraction interventions are supportive techniques that employ humor, relaxation, music, imagery, as well as VR to alleviate symptoms

such as pain, anxiety, nausea, fatigue, as well as tension. Psychological symptoms may also be alleviated through distraction [7].

The goal of the study was to compare between the effect of Pilates exercise and virtual reality on improving upper limb dysfunction post-mastectomy

MATERIALS AND METHODS

• Subjects

Sixty female patients with upper limb dysfunction post Mastectomy participated in this study. Their ages ranged from 35 to 55 years. The participants were selected from physical therapy clinic in national cancer institute and from department 11 in kisrel ainihospital, The subject selection was based on the subsequent criteria:(1) Age ranges from 35–55 years. (2) Only females participated in the study.(3) Patients that had upper limb dysfunction post –mastectomy (4) Postsurgical duration was from 1–3 months.(5) All patients enrolled on the study had their informed consent.If a prospective participant fulfilled any of the subsequent conditions, they were not included in the study: (1) Subjects suffering from active malignant tumors or bilateral breast cancer (2) Patients who had lymphedema (3) Visual disorders that interfered with a video game–based exercise. (4) Subjects with cognitive disorders, mental disorders, or cooperation issues,(5)Subjects with vascular or cardiopulmonary disorders (6) Presence of pacemaker or infection.

• Design of the study:

Randomized controlled trial was carried out in physical therapy clinic in national cancer institute and outpatient clinic in faculty of physical therapy Cairo university

The participants in this study were allocated into two groups using a random assignment method (30 patients for each group):

Group (A) Pilates exercise

This group included 30 patients with upper limb dysfunction post mastectomy received Pilates exercise plus conventional physical therapy program (Mobilization exercises and Range of motion exercises) and routine medical treatment. Each patient had a 40-minute session three times weekly for eight weeks.

Group (B) virtual reality

This group included 30 patients with upper limb dysfunction post mastectomy received virtual reality in addition to conventional physical therapy program (Mobilization exercises and Range of motion exercises) and routine medical treatment. Patients received 3 sessions per week for 8 weeks, time of the session was 40 min.

• Sample size determination

Prior to enrolling participants, we utilised the G*POWER statistical software to determine the required number of patients necessary to detect a significant impact at a significance level of 0.05. This was done using F tests as well as MANOVA, considering both repeated measures within as well as among interaction measurements. We assumed an effect size of 0.27 as well as a power of 0.8 for limb volume measurement. It was decided that a sample size of 60 was sufficient for this study.

OUTCOME MEASURES

- **Smartphone inclinometer**

A smartphone application known as “Clinometer” (CA) + bubble level was used in this study. It is accessible on the Google Play store, it was used in this study to assess range of motion, it can measure the degree of inclination or tilt from a neutral position on a plane surface when used perpendicular to a surface and when kept in horizontal direction, Shoulder flexion and abduction was assessed from sitting or standing and shoulder external rotation will be assessed from supine lying position [8].

- **Arabic version of American Shoulder and Elbow Surgeons Evaluation Form[ASES]**

The ASES form was utilized to evaluate the function of the upper limbs. The self-report section is divided into two categories: pain as well as ADL. The cumulative ADL score as well as the pain score were each equalized to 50 points and combined to produce a total score (possibly 100 points). The total ASES score is determined by a pain question that utilizes VAS and ranges from 0 (no pain) to 10 (worst pain), as well as function during ADL (1. Comb hair, 2. Sleep on painful shoulder, 3. Wash back, 4. Manage toileting, 5. Reach high shelf, 6. Put on a coat). 7. Lift a weight of 10 pounds above the shoulder, 8. Throw a ball overhand, 9. Perform routine tasks, and 10. Participate in the customary sport. Each shoulder was evaluated separately for these ADL [9].

- **Camry Electronic Hand dynamometer**

It was employed in this investigation to quantify the maximum isometric grip strength. An additional benefit of this Electronic hand-held dynamometer is its ability to automatically record the highest grip strength achieved, which can be adjusted to a maximum of 198 lbs. (90 kg) and displayed. The initial position involved sitting upright on a chair with a straight back, ensuring that both feet were firmly planted on the floor. The hand to be examined was positioned on the armrest of a chair or bed, with the shoulder brought close to the body and in a neutral rotation. The measurement was taken using a bent elbow. The dynamometer handle was adjusted using the base sitting on the metacarpal (heel of the palm), while the hand was positioned on the middle of the four fingers. Each patient was provided with a demonstration of the therapist's maximal hand grip strength. The patient was instructed to exert maximal isometric force by squeezing the dynamometer, and to maintain this effort for approximately 5 seconds. Any form of bodily movement was not permitted. The patient was continually motivated by providing instructions to “squeeze harder and harder” [10].

INTERVENTION:

Conventional physical therapy program (Mobilization exercises and Range of motion exercises) were given to both groups.

(a) The procedure of Pilates exercise:

First the patients were educated and performed the proper alignment of body, From supine lying position, the patient was in crock lying position with a distance of fist between both knees, generally neutral spine, pelvis is neutral also aligned and parallel to the floor, shoulders were not elevated and away from the ears not rounded forward, shoulder blades were abducted and depressed, knee joint is directly below hip joint not bowing out or knocking in, feet parallel to each other, subtalar joint is neutral, feet are not pronated or supinated [12]. Patients performed bridging exercises, scapular retraction and protraction, scapular elevation, and depression. the

patient performed Pilates–based mat exercises and from sitting or standing position (in form of dumb waiter, Cleopatra, lifting upper limbs with wands , sitting raised arms with rod and Pilates–based Thera band exercises (in form of triceps with band , dump waiter , hug a tree) [11] , [12] , [13]. Repetitions of the exercise were 10 Repetitions [14].

(b) The procedure of Virtual reality:

Virtual reality was performed by using oculus VR head set with 2 controllers.

The controllers were demonstrated to them. The correct method of grasping them and the keys that were utilized during the various stages of the exercises were outlined. The games were briefly demonstrated to the patients, who were informed of the objectives of each game along with the rationale behind its selection for the specific movements basketball and volleyball games were used in which the patient made elevation in her upper limb to throw the ball , The patient started the games with the use of the controllers and the physical therapist encouraged the patient while playing rest was given to the patient in between to decrease the chance of dizziness occurrence while playing. Before proceeding to the subsequent patient, the session concluded with the thorough cleaning of all materials [15].

Statistical analysis

Unpaired t-test was performed to compare the age as well as postoperative duration among the groups. A chi-squared test was performed to compare the distribution of afflicted sides among the groups. The data was assessed for normal distribution with the Shapiro-Wilk test. The Levene's test was performed to assess the homogeneity of variances among the different groups. A unpaired t-test was used to compare ROM in the shoulder, ASES score, as well as hand grip strength among the groups. A paired t-test was performed to compare the prior to as well as following treatment measurements within each group. The statistical tests were conducted with a predetermined level of significance of $p < 0.05$. The statistical analysis was performed using the SPSS software package, specifically version 25 for Windows, developed by IBM SPSS in Chicago, IL, USA.

- Results

- Subject characteristics:

Table (1) presented the participants characteristics of group A as well as B. There was no substantial difference among groups in age, postoperative duration as well as afflicted side distribution ($p > 0.05$).

Table 1. Comparison of subject characteristics between group A and B:

	Group A	Group B	MD	t- value	p-value
	Mean±SD	Mean±SD			
Age (years)	46.97 ± 4.12	45.87 ± 3.78	1.1	1.07	0.28
Postoperative duration (weeks)	7.37 ± 1.65	7.90 ± 1.75	-0.53	-1.22	0.22
Affected side, N (%)					
Right side	15 (50%)	17 (57%)		$\chi^2 = 0.27$	0.61
Left side	15 (50%)	13 (43%)			

SD, Standard deviation; MD, Mean difference; χ^2 : Chi squared value p value, Probability value

Effect of treatment on shoulder ROM, ASES and hand grip:

• **Within group comparison**

There was a substantial improvement in shoulder flexion ROM, ASES as well as hand grip following treatment in both groups contrasted with that prior to treatment ($p < 0.001$). The percent of change in shoulder flexion, abduction and external rotation, ASES and hand grip of group A was 42.49, 35.49, 56.87, 76.09 and 14.45% respectively and that in group B was 21.83, 26.52, 35.62, 38.85 and 8.49% respectively. (table 2-3).

• **Between group comparison**

There was no substantial difference among groups prior to treatment ($p > 0.05$). Comparison among groups following treatment showed a substantial improvement in shoulder ROM, ASES as well as hand grip of group A contrasted with that of group B ($p < 0.01$). (table 2-3).

Table 2. Mean shoulder flexion, abduction and external rotation pre and post treatment of group A and B:

ROM (degrees)	Group A	Group B	MD	t-value	p value
	Mean±SD	Mean±SD			
Flexion					
Pre treatment	90.23 ± 11.46	93.47 ± 10.61	-3.24	-1.13	0.26
Post treatment	128.57 ± 12.14	113.87 ± 9.62	14.70	5.19	0.001
MD	-38.34	-20.4			
% of change	42.49	21.83			
t-value	-31.85	-21.28			
	<i>p = 0.001</i>	<i>p = 0.001</i>			
Abduction					
Pre treatment	83.60 ± 9.69	85.10 ± 7.42	-1.5	-0.67	0.50
Post treatment	113.27 ± 9.94	107.67 ± 6.61	5.60	2.57	0.01
MD	-29.67	-22.57			
% of change	35.49	26.52			
t-value	-35.41	-27.32			
	<i>p = 0.001</i>	<i>p = 0.001</i>			
External rotation					
Pre treatment	50.17 ± 8.05	52.13 ± 7.31	-1.96	-0.99	0.33
Post treatment	78.70 ± 9.02	70.70 ± 7.57	8	3.72	0.001
MD	-28.53	-18.57			
% of change	56.87	35.62			
t-value	-29.19	-27.97			
	<i>p = 0.001</i>	<i>p = 0.001</i>			

SD, Standard deviation; MD, Mean difference; p value, Probability value

Table 3. Mean ASES and hand grip pre and post treatment of group A and B:

	Group A	Group B	MD	t-value	p value
	Mean±SD	Mean±SD			

ASES					
Pre treatment	25.93 ± 9.07	27.26 ± 7.98	-1.33	-0.60	0.55
Post treatment	45.66 ± 10.87	37.85 ± 10.56	7.81	2.82	0.006
MD	-19.73	-10.59			
% of change	76.09	38.85			
t-value	-37.45	-16.04			
	<i>p = 0.001</i>	<i>p = 0.001</i>			
Hand grip (lb)					
Pre treatment	26.99 ± 1.67	27.08 ± 1.23	-0.09	-0.24	0.81
Post treatment	30.89 ± 1.84	29.38 ± 1.45	1.51	3.53	0.001
MD	-3.9	-2.3			
% of change	14.45	8.49			
t-value	-29.44	-24.51			
	<i>p = 0.001</i>	<i>p = 0.001</i>			

SD, Standard deviation; MD, Mean difference; p value, Probability value

Ethical approval

This trial has been approved by the Ethical Committee of the Faculty of Physical Therapy, Cairo University, and has been certified with the reference number P.T.REC/012/003511. It adheres to all relevant national regulations and institutional standards.

DISCUSSION

The outcomes of this investigation indicated that there was a substantial improvement in shoulder flexion ROM, ASES as well as hand grip following treatment in both groups contrasted with that prior to treatment ($p < 0.001$). The percent of change in flexion, abduction in addition external rotation of shoulder, ASES as well as hand grip of group A was 42.49, 35.49, 56.87, 76.09 and 14.45% respectively and that in group B was 21.83, 26.52, 35.62, 38.85 and 8.49% respectively. following treatment, a comparison between the groups showed a noteworthy improvement in shoulder ROM, ASES score, as well as hand grip strength in group A compared to group B ($p < 0.01$).

In the present study, effects of Pilates exercise versus virtual reality on upper limb dysfunction post mastectomy were investigated. Sixty female patients with ages ranging from 35 to 55 years suffering from. The participants were chosen from the outpatient clinic of physical therapy at the National Cancer Institute and El Kasr El Aini.

Measurements were conducted before starting the study initially, as the first record, and subsequently at the completion of the study after a duration of 8 weeks using Smartphone inclinometer , Arabic version of American Shoulder and Elbow Surgeons Evaluation Form and electronic Hand dynamometer

Group A exhibited a substantial improvement in flexion, abduction, in addition external rotation ROM of shoulder, ASES scores as well as hand grip strength, compared to group B following treatment.

Pilates enhances flexibility, builds strength, as well as develops control and endurance throughout the entire body. The practice places great emphasis on achieving proper alignment, regulating breath, developing a robust core, and enhancing coordination and balance. The core, which comprises the abdominal, lumbar, and hip muscles, is commonly referred to as the "powerhouse" and is believed to be crucial for an individual's stability [16] .

Virtual Reality (VR) is an innovative technology that involves the use of computer hardware and software to generate interactive simulations. These simulations allow users to experience surroundings that closely resemble real-world occurrences. In addition to offering an interactive rehabilitation session, VR can offer a rehabilitation environment that enables users to complete several exercises that are acknowledged as crucial components in rehabilitation, such as repeating the same exercises with sufficient motivation. Furthermore, the experience of therapy is enhanced, the impression of pain is less, and movement is enhanced [7] ..

Results of this study concerning the effect of Pilates exercise confirmed the observations of studies done by: (De Rezende et al., 2022, et Odynets al ,2019, Atilgan et al. 2017, Kapila and Palekar,2017 ,Zengin et al ,2016, Ghorbani et al , 2013, , Poonam 2013 , Stan et al.2012 , Keays et al. 2008) .

De Rezende et al ,2022 [17]assess the impact of Pilates exercises on the functional ability, pain levels, as well as QOL among breast cancer survivors a year following surgery. A group of 44 individuals who had previously struggled breast cancer took part in a 24-session Pilates exercise program, during which they engaged in Pilates movements for 60 minutes, twice a week. The assessment of functional capacity was conducted using the Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) as well as the Shoulder Pain and Disability Index (SPADI). An analysis was conducted on both pain as well as QOL. After completing all sessions, there was a noticeable reduction in pain scores along with a significant improvement in QOL.

Odynets et al ,2019[18] The objective of the investigation was to evaluate the efficacy of two tailored physical interventions on the condition of the upper limbs following radical mastectomy. A total of 68 patients who underwent breast cancer surgery underwent 12-week outpatient rehabilitation. The participants were randomly assigned to either the water exercise group (n = 34) or the Pilates group (n = 34). The mean values of active range of flexion as well as abduction were statistically greater in the water exercise group than in the Pilates group, despite the fact that both groups were given 36 tailored rehabilitation sessions, each lasting one hour, over a three-month period. Water exercises were more efficient in enhancing the mobility as well as muscle force of the upper limb than Pilates exercises, whereas there were no statistically substantial variations in upper limb force among the studied groups. He concluded that tailored physical interventions could be regarded effective methods for enhancing the ROM in post-mastectomy syndrome.

Atilgan et al. ,2017 [19] who examined the impact of Pilates exercise in comparing with conventional exercise on 33 patients with shoulder pain within 30 days. The patients underwent treatment for 5 days per week, with a total treatment duration of 10 days. The study demonstrated a noteworthy enhancement in the effectiveness of Clinical Pilates exercise compared to traditional exercise.

Kapila and Palekar ,2017 [20] who investigated the impact of Pilate's exercises in addition to conventional therapy on the function as well as QOL of 30 patients in the upper limbs following a mastectomy. Clinical trials have shown that Pilates exercises have better results than conventional therapy for improving upper limb function as well as QOL among women who have undergone a mastectomy.

Zengin et al ,2016[14] The objective of this investigation is to evaluate the efficacy of Pilates-based exercises (PE) in the rehabilitation of UE disorders associated with breast cancer treatment

in comparison to combined exercise (CE) as well as home exercise (HE) groups. 45 patients were randomly assigned to PE, CE (which included strengthening, stretching, in addition ROM exercises), as well as HE (which included CE group exercises). Certain enhancements were preferable to those of the HE group. In contrast to the CE group, PE appeared to produce comparable enhancements in functional status, muscle strength, as well as pain. They determined that PE appears to be a viable alternative to CE for the rehabilitation of patients with UE disorders associated with breast cancer treatment.

Ghorbanietal ,2013[21] This quasi-experimental investigation was conducted on 25 patients who were randomly selected from the patients who were referred to the Cancer Institute. The control group was performing routine active exercises at the physiotherapy center, while the designed exercise consisted of five "Mat Pilates" movements that were performed over the course of 15 sessions. The results indicated a substantial disparity between the flexion, extension, internal, and external rotation of the shoulder, flexion and extension of the elbow, flexion, extension, supination deviation, along with pronation deviation of the wrist and forearm prior to and following the experiment in the Pilates group. While the control group exhibited a substantial difference in flexion, extension, internal and external rotation of the shoulder, flexion and extension of the elbow, and flexion of the wrist prior to and following the experiment. The study determined that the application of Pilates exercises following mastectomy surgery can enhance the ROM of the upper limb on the affected side, reduce edema, as well as improving the upper limb's mobility.

Poonam ,2013 [22] The study was conducted among 30 married women aged 25 to 65 years. There were two separate groups, each consisting of 15 patients. The experimental group received Pilates exercises as treatment, whereas the control group received conventional therapy. The QOL& Wingate scale is utilized for assessment purposes. The Wingate scale specifically focuses on evaluating the upper extremity function of post-mastectomy patients. When comparing the experimental and control groups, both groups shown improvement in UE function as well as QOL. However, the experimental group exhibited greater improvement, suggesting that Pilates exercises are more beneficial than conventional therapy.

Stan et al ,2012 [23] who demonstrated the impacts of clinical PE on physical parameters among post-mastectomy survivors. 15 patients were incorporated into the investigation then exercises had been conducted for three months. They revealed a great enhancement of shoulder ROM on the influenced side. There is likewise an examination which is researching the feasibility of Pilate's program on shoulder function as well as ROM.

Keayset al. ,2008 [24]who conducted an investigation examined how Pilate's activities affected the ROM, pain, and UE function among women who had received treatment for breast cancer. Four females partook in the investigation and Pilate's exercises were connected for three months. The researchers found that Pilate's exercises had positive effects, specifically on the ROM for abduction as well as external rotation. They concluded that Pilates activities could be a powerful and safe option for exercising.

Results of this study concerning the effect of Virtual reality confirmed the observations of studies done by: (Mogahed et al , 2024, Wu et al, 2024 , Feyzioğlu et al ,2020, Atef et al. 2020 , Gupta & Hende , 2019 , Macarena & Paula , 2018, House et al, 2016).

Mogahed et al ,2024 [25] investigated how VR affected females experiencing menopause after a mastectomy in terms of pain and anxiety. A total of 30 women who reported anxiety as well as

unilateral shoulder pain following a mastectomy were divided into two groups of similar size. Those in Group A who had both VR along with conventional physical treatment. Those in Group B who underwent conventional physical treatment. Over the course of three weeks, each group met for three therapy sessions. Participants' ages varied from 45 to 55 and were sourced from Om Elmasreen hospital. Following treatment, there was a statistically substantial variance among the two groups with respect to the level of pain; the study group reported significantly less pain than the control group. VR. There was a statistically significant difference in anxiety levels among the two groups, and the majority of patients receiving unilateral post-mastectomy were satisfied with the VR treatment.

Wu et al , 2024 [26] A phenomenological qualitative investigation was done between September and December 2021. Eighteen breast cancer patients who had received surgical treatment were interviewed using open-ended questions. The VR system's gamified nature appeared to enhance engagement in VR-based rehabilitation compared to traditional rehabilitation, especially during early rehabilitation. However, the expensive cost of VR equipment posed challenges for implementing VR-based rehabilitation at home. The researchers determined that the patients with breast cancer who were interviewed had favorable experiences when utilizing VR for rehabilitation purposes. The excessive expenses associated with both VR software and hardware creation provide a significant obstacle to the implementation of VR-based rehabilitation.

Feyzioğlu et al ,2020 [27] participated in a study that compared two groups of breast cancer patients: those who received standardized physical therapy group (SPTG) and those who received Kinect-based rehabilitation group (KBRG). The participants in the study were 40 women who had undergone unilateral mastectomy along with axillary lymph node dissection and were undergoing adjuvant therapy. Twenty KBRG patients underwent VR therapy, whereas twenty SPTG patients underwent conventional physical therapy. Participants were evaluated both before and after the 6-week course of therapy. Significant alterations in pain, ROM, strength, grip strength, as well as functionality were noted by both groups. While the SPTG showed better functional improvement, the KBRG showed a marked improvement in fear of movement. Both groups reported similar levels of pain, ROM, muscle strength, as well as grip strength following treatment. In the early postoperative period of patients who had undergone breast cancer surgery, they found that Kinect-based VR therapy produced substantial benefits that were similar to those achieved with conventional physiotherapy.

Atef et al,2020 [28] evaluated the efficacy of VR for lymphedema treatment as well as upper limb functional improvement in comparison to the PNF approach. VR therapy included use of tennis, triceps extension, as well as rhythmic boxing video games. After the VR session, both study variables showed a substantial improvement, according to the findings.

Gupta & Hende, 2019 [29] conducted a study to assess the impact of VR on anxiety as well as pain among patients recovering from mastectomy. Thirty patients, ranging in age from forty to seventy, were advised to lie down or sit comfortably during the program. At the end of the first day, the patient spent ten minutes using the VR device. After that, they were instructed to take it off if it caused any pain, such as a headache or dizziness. Researchers found that patients experiencing post-mastectomy anxiety benefited from a VR training, and they continued to extend the duration of the session until it reached 30 minutes.

Macarena & Paula,2018 [30] Conducted a descriptive study on 77 women who underwent unilateral mastectomy without shoulder pathologies (41 study, 36 control). The women were categorized by the form of mastectomy: partial with sentinel lymph node (PMSL), partial with axillary dissection (PMAD), as well as modified radical mastectomy (MRM). A physical

rehabilitation protocol that included VR exercises (based on the Wii™ console) was implemented on the seventh day following the surgery. The risk of depression and anxiety (HADS) in addition the grade of upper limb ipsilateral function of mastectomy (Quick DASH) was assessed in patients. Measurements were taken prior to surgery (preoperative-day 0) then on days 7 and 30 following the procedure. Mastectomized patients who undergo early physical rehabilitation using VR (Wii™ console) experience an improvement in upper limb ipsilateral function, particularly in the MRM group. Conversely, they experience a decline in the risk of anxiety and depression, in contrast to the control group, which maintains the risk. Consequently, they concluded that mastectomy patients who undergo early physical rehabilitation with VR achieve an increase in the functionality of the ipsilateral upper extremity as well as a reduction in the risk of depression and anxiety.

House et al, 2016[31] A study was conducted that involved six women who experienced pain in their upper arm after undergoing breast cancer surgery. The women were trained on the VR system twice a week for a period of eight weeks. The level of difficulty in training increased gradually as the complexity of the game, the tilt of the table, and the duration of the session (20–50 minutes). Prior to and following therapy, standardized assessments were administered to evaluate pain, cognition, emotion, UE function, as well as ADL. The results suggest that there is an improvement in depression, strength, function, shoulder range, as well as cognition.

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Disclosure statement

There is no conflict of interest between the authors and the study presented here.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

Limitations:

This study was limited by:

- 1) Differences between oncology surgeons participated in this study, in preferences, skills and experience
- 2) Physical condition of the patient during the period of treatment
- 3) Psychological state of the patient during the period of treatment
- 4) Individual differences in patients and their response to the treatment
- 5) Possible human errors
- 6) Patient nutrition
- 7) Patient compliance

Conclusion :

Pilates exercise is useful approach in decreasing upper limb dysfunction post -mastectomy , in expression of increasing shoulder range of motion , upper limb function and hand grip and also virtual reality is useful in decreasing upper limb dysfunction and improving psychological state of patient , finally Pilates exercise is superior to virtual reality in improving upper limb dysfunction

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REFERENCES

- 1- Kaur, N., Petit, J. Y., Rietjens, M., Maffini, F., Luini, A., Gatti, G., Rey, P., Úrban, C., & De Lorenzi, F. (2005). Comparative study of surgical margins in oncoplastic surgery and quadrantectomy in breast Cancer. *Annals of Surgical Oncology*, 12(7), 539–545.
- 2- Steiner, C., Weiss, A. J., Barrett, M. L., Fingar, K. R., & P Hannah Davis. (2016). Trends in Bilateral and Unilateral Mastectomies in Hospital Inpatient and Ambulatory Settings, 2005–2013.
- 3- Levy, E. W., Pfalzer, L., Danoff, J. V., Springer, B. A., McGarvey, C. L., Shieh, C., Morehead–Gee, A., Gerber, L. H., & Stout, N. L. (2012). Predictors of functional shoulder recovery at 1 and 12 months after breast cancer surgery. *Breast Cancer Research and Treatment*, 134(1), 315–324.
- 4- Shamley ,D. , Lascurain–Aguirrebeña ,I. , Oskrochi R., &Srinaganathan R. (2012).Shoulder morbidity after treatment for breast cancer is bilateral and greater after mastectomy, *ActaOncologica*, 51: 8, 1045–1053
- 5- Eyigör, S., Karapolat, H., Yeşil, H., Uslu, R., &Durmaz, B. (2010). Effects of pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients: a randomized controlled study. *PubMed*, 46(4), 481–487.
- 6- Cruz–Ferreira, A., Fernandes, J., Laranjo, L., Bernardo, L. M., & Silva, A. (2011). A Systematic review of the effects of Pilates method of exercise in healthy people. *Archives of Physical Medicine and Rehabilitation*, 92(12), 2071–2081.
- 7- Zasadzka, E., Pieczyńska, A., Trzmiel, T. and Hojan, K. (2021). Virtual Reality as a Promising Tool Supporting Oncological Treatment in Breast Cancer. *International Journal of Environmental Research and Public Health*, 18(16)
- 8- Dixit B and Neema M (2016): " Use of an Android application “clinometer” for measurement of head down tilt given during subarachnoid block ". *Saudi J Anaesth.* ; 10(1): 29–32.
- 9- Piitulainen, K., Paloneva, J., Ylinen, J., Kautiainen, H., &Häkkinen, A. (2014). Reliability and validity of the Finnish version of the American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, patient self-report section. *BMC Musculoskeletal Disorders*, 15(1).
- 10-Paramasivan M, Kiruthigadevi S and Amal K, (2019): "Test–Retest Reliability of Electronic Hand Dynamometer in Healthy Adults.". *Int. J. Adv. Res.* ;7(5), 325–331
- 11- Rapuzzi, L. A. (2021). *Pilates and breast cancer recovery*. Litres .
- 12- Wood, S. (2019). *Pilates for rehabilitation*. Champaign, Il: Human Kinetics.
- 13-Şener, H. Ö., Malkoç, M., Ergin, G., Karadibak, D., &Yavuzşen, T. (2017). Effects of Clinical Pilates Exercises on Patients Developing Lymphedema after Breast Cancer Treatment: A Randomized Clinical Trial. *The journal of breast health*, 13(1), 16–22.
- 14- Zengin A, Razak O and KaranlikH , (2016): "Effectiveness of Pilates–based exercises on upper extremity disorders related with breast cancer treatment ". *Eur J of cancer care*; (26) 6
- 15- M–Carmen J ,Julen E , Paulo D , Beatriz S , Paula A (2023): “Immersive virtual reality for upper limb rehabilitation: comparing hand and controller interaction.“*Virtual Reality* ; 27: 1157–1171
- 16-Bradt, J., Shim, M., &Goodill, S. W. (2015). Dance/movement therapy for improving psychological and physical outcomes in cancer patients. *The Cochrane Library*. 7;1(1)

- 17-De Rezende, L. F., Thesolim, B. L., De Souza, S. D., Nagib, A., & Boas, V. F. V. (2022). The effects of a pilates exercise program on pain, functional capacity, and quality of life in breast cancer survivors One yearpostsurgery. *Oncology Nursing Forum*, 49(2), 125-131.
- 18-Odynets, T., Briskin, Y., Yefremova, A., & Гончаренко, С. (2019). The effectiveness of two individualized physical interventions on the upper limb condition after radical mastectomy. *Physiotherapy Quarterly*, 27(1), 12–17.
- 19-Atılgan, E., Aytar, A., Çağlar, A., Tıgılı, A. A., Arın, G., Yapalı, G., Kısacık, P., Berberoğlu, U., Şener, H. Ö., & Ünal., E. (2017). The effects of Clinical Pilates exercises on patients with shoulder pain: A randomised clinical trial. *Journal of Bodywork and Movement Therapies*, 21(4), 847–851.
- 20-Kapila, T., & Palekar, T. (2017). The effect of pilates exercises and conventional therapy on upper limb function and quality of life in post– mastectomy women: a comparative study. *International Journal of Scientific Research in Education*, 5(06).
- 21-Ghorbani, M., Sokhangouei, Y., & Sadeghi, H. (2013). Effect of Pilates Exercise on Range of Motion and Edema of Upper Limb in Mastectomy Side. *Journal of Ardabil University of Medical Sciences*, 13(3) p. 297–304
- 22-Poonam, P. (2013). To compare the effects of Pilates exercises and Conventional therapy on Upper Extremity Function and Quality of Life in women with breast cancer. *The Indian Journal of Occupational Therapy*: 45(1)
- 23-Stan, D., Rausch, S. M., Sundt, K., Cheville, A. L., Youdas, J. W., Krause, D. A., Boughey, J. C., Walsh, M. F., Stephen, S., & Pruthi, S. (2012). Pilates for breast cancer survivors. *Clinical Journal of Oncology Nursing*, 16(2), 131–141
- 24-Keays, K. S., Harris, S., Lucyshyn, J. M., & MacIntyre, D. L. (2008). Effects of pilates exercises on shoulder range of motion, pain, mood, and Upper–Extremity function in women living with breast cancer: a pilot study. *Physical Therapy*, 88(4), 494–510.
- 25-Mogahed, H. G., Hamoda, R. E., & Elkalla, R. A. (2024). Virtual reality on pain and anxiety after modified radical mastectomy in menopause. *Research Journal of Pharmacy and Technology*, 1657–1661.
- 26-Wu, S. C., Chuang, C. W., Liao, W. C., Li, C. F., & Shih, H. H. (2024). Using Virtual Reality in a Rehabilitation Program for Patients With Breast Cancer: Phenomenological Study. *JMIR serious games*, 12, e44025.
- 27-Feyzioğlu, Ö., Dinçer, S., Akan, A., & Alğun, Z. C. (2020). Is Xbox 360 Kinect–based virtual reality training as effective as standard physiotherapy in patients undergoing breast cancer surgery? *Supportive Care in Cancer*, 28, 4295–4303
- 28-Atef, D., Elkeblawy, M. M., El–Sebaie, A., & Abouelnaga, W. A. (2020). A quasi–randomized clinical trial: Virtual reality versus proprioceptive neuromuscular facilitation for postmastectomy lymphedema. *Journal of the Egyptian National Cancer Institute*, 32(1).
- 29-Gupta, N. and Hande, D. (2019). Is virtual reality program is effective in reducing anxiety in post mastectomy among breast cancer patient. *International Journal of Multidisciplinary Research and Development*, 6(3), pp.32–35.
- 30-Macarena A. & Paula M. (2018) “Psychological and Functional Effects in Mastectomized Patients Treated With Virtual Reality.” *Canc Therapy & Oncol Int J.*; 9(3): 555763.
- 31-House, G., Burdea, G., Grampurohit, N., Polistico, K., Roll, D., Damiani, F., Hundal, J., & Demesmin, D. (2016). A feasibility study to determine the benefits of upper extremity virtual rehabilitation therapy for coping with chronic pain post–cancer surgery. *British Journal of Pain*, 10(4), 186–197