

# Use of Xbox Kinect 360 Video Game for Rehabilitation of Sports Specific ACL Sprain During Lockdown Period due to COVID-19 Pandemic

Pydi Revathi <sup>1</sup>, Duppala Sateesh Kumar <sup>\*2</sup>, Rahul Shaik <sup>3</sup>.

<sup>1,\*2,3</sup> GEMS College of Physiotherapy, Ragolu, Srikakulam, Andhra Pradesh, India.

## ABSTRACT

**Background:** Anterior cruciate ligament is one of the two ligaments inside the middle section of the knee joint that forms an "X" shape. Its main function is to prevent the tibia from sliding forward relative to the femur. The ACL also assists with preventing excessive knee extension, knee varus and valgus movements, and tibial rotation. Kinect works in almost all room lighting conditions and can simultaneously track two active users. For full-body, head-to-feet tracking, the recommended user distance from the sensor is approximately 1.8 m for a single user; when two people are to track simultaneously, they should stand approximately 2.5 m away from the device. Kinect requires a minimum user height of 1 m. With the players themselves becoming the 'game controller' via their body movements and gestures, Kinect-enabled game titles lend themselves comfortably to the class of exergames ('exercise games'), although the amount of physical activity involved and calories burned can vary significantly from title to title

**Materials and method:** Twenty-six participated in the study. These subjects were divided into two groups, 13 subjects in each. Group A was administrated with the traditional training, and Group B was administrated with the X BOX Kinect training.

**Results:** Comparison of mean and standard deviation of subjects aged (18-25) between Group A (Traditional Training) and Group B (X box Kinect 360 Training). The mean age of Group A was 20.7143±1.98278, and Group Bs was 20.6571±2.21711, respectively. The paired t-test value was 15.728. There was no significant difference between age groups. But in both Kujala score and muscle girth scores with p-value <0.001\*\* (i.e., p <0.05 at 95 % confidence interval), the pre and post-values of Kujala score and muscle girth were statistically significant.

**Conclusion:** Comparing traditional treatments with or without adding extra Kinect 360 training sessions would be very interesting, being that it may be a good addition to the treatment for post-operative ACL rehab, ACL sprains conservative management, and maintaining Knee joint fitness when sports players in a home without exposure of COVID -19.

**KEYWORDS:** Xbox Kinect-360, ACL Sprain, Home-Based Exercises, Kujala Scale, COVID-19, Remote Rehabilitation.

**Address for correspondence:** Duppala Sateesh Kumar, Associate Professor, Ragolu, Srikakulam, Andhra Pradesh, India. mobile: +91 9501105203 **E-Mail:** [sateeshphysio96@gmail.com](mailto:sateeshphysio96@gmail.com)

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## INTRODUCTION

An anterior cruciate ligament (ACL) is one of the two ligaments inside the middle section of the knee joint that mainly prevents the tibia

from sliding forward relative to the femur. The ACL also assists with preventing excessive knee extension, knee varus and valgus movements, and tibial rotation [1,2]. An intact ACL protects

the menisci from shearing forces during athletic maneuvers. Both Competitive and recreational athletes between the ages of 15 to 35 years are at the greatest risk of ACL injury, including non-contact sports, which is most common in ACL injuries [3]. Over the past 20 years, there has been considerable growing attention to rehabilitation programs for post-ACL reconstruction, but still, no optimal rehabilitation program has been found [4]. Despite surgical repair, approximately 79% of those individuals develop knee osteoarthritis (OA), and 20% suffer re-injury within two years [5]. Traditionally sports physios use PRICE protocol in the early stage to subside swelling along with electrotherapy to decrease pain, later to increase Range of motion, improve strength and proprioception, etc., pyramid shape rehab advice by sports physiotherapy clinic [6-9].

Uncertainly from 2019, the world faces the coronavirus; from early 2020 onwards, most WHO-aided countries follow the strict public locked down implemented by the government of India in all its states. According to WHO, the new health protocol guidelines implemented in the majority of the countries along with India, such as social distancing, not going outside, and closing rehabilitation centers, GYM centers, among the first line of measurement so, home base rehab exercise and measurements of the recovery, online video rehab popular in this pandemic. For training remotely, the X box Video games provided an effective, efficient, and enjoyable training method and are a helpful addition to rehabilitation [5].

Launched by Microsoft in November 2010, Kinect is a motion-sensing input device for the Xbox 360 gaming console<sup>6</sup>. There has been no study or document to compare ACL injury training and Xbox Kinect 360 video game training in improving the performance of ACL rehab, especially in sports during covid 19 lockdown. It is essential to improve the status of ACL rehab in India, so the present study was designed to explore effective new techniques in ACL rehabilitation for emergency situations where patients cannot go outside the clinic. This study's authors aimed to

determine the effectiveness of XBOX Kinect 360 training in improving performance and compare the efficiency of XBOX Kinect 360 video game training over traditional home-based rehab training for ACL injury.

## MATERIALS AND METHODS

This study was an experimental design comparative in nature with tele physiotherapy. After ethical approval from the Institutional ethical committee, the samples were taken as conveniently as thirty people for this study. After the consent form, Subjects who fulfilled the inclusion criteria were selected. All participants underwent a pre-participation physical evaluation assessment, then divided into groups A of 15 subjects and B of 15 subjects.

The professional and recreational players aged between 14 and 25 years of both genders were selected. People residing near coastal areas who have known to swim and not having hydrophobia were preferred in this study. The following problems with the samples were excluded: (1. Lower limb fractures. 2. Patients who have congenital lower limb deformities. 3. ACL with another ligament or meniscus tear. 4. Spinal deformity-scoliosis and kyphosis, 5. Any Vision problems, i.e., Color blindness, Symptomatic Covid 19 positive patient). The main outcome was measured with the Kujjala scale and measuring tape.

**Instruments and tools:** Console, Sensor, LCD TV, SHAPE, KINECT SPORTSETC (LOWER limb-related excise CDS). Universal goniometer. Smart Mobile, Walker, and axillary crutches. Commercial ice bag, crushed ice, elastic crepe bandage (medium size).

### Procedure:

The study was designed in which 30 ACL injury patients taken after MRI screening grade 1 and 2 injuries that all are different types of sports players (especially cricket fast bowlers, cricket fielders, basketball players, soccer, kabaddi, badminton players who got injured during the match), age between 18 to 25 years old, both male and female sports players participated after taking online consent form. All participants must have their radiological MRI screening report before lockdown, both

operated and non-surgical intervention participants, post operated discharge summary; after that, we started checking the pre-participation physical evaluation [23].

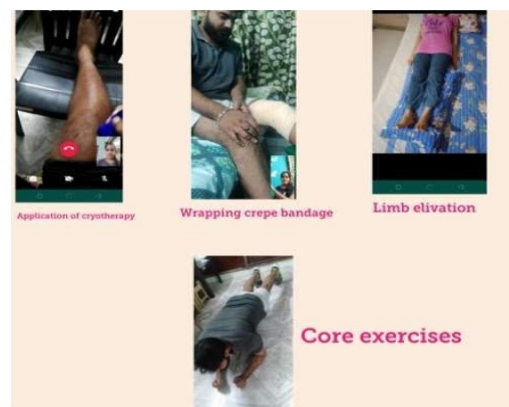
After taking the consent form, we divided patients into two groups by lottery method. In that group A, 15 members (1 participant middle of rehab got Covid-19, and another participant got a smart mobile problem), the remaining 13- 09 males and four females. And group B 15 (2 participants got Covid -19 positive symptoms), 13 members, 09 males and 4 females. We gave Kujjala questionnaires and ask them WhatsApp online video calling to fill out the form. The patient must take the round measuring tape and measure his thigh measurements; both affected and unaffected leg.

**Group A is a Conventional group** in that authors advised to utilize physician-prescribed vitamins, mineral supplements, and NSAID. On WhatsApp video call monitor by the therapist and the patient is supposed to wear a crepe bandage, cryotherapy, elevated leg during resting position, Quadriceps isometric exercise, Non-weight-bearing hip exercise, sitting aerobic exercise to maintain overall fitness, self-sports massage in and around knee muscles, assisted crutch partial weight-bearing exercise, one's patient able to walk without crutches advised up to hip level under sea water aquatic exercise near the beach - as most of our patient from east coastal corridor performed near to bay of Bengal sea water (Non-weight bearing ) during early morning when temperature not that much hot and humid, patient will carry enough drinking water, before 1 hour lite breakfast. sea water free exercise- up to the hip level, he went into the sea. He performed front walking, back-walking, side walking, lunges, squats, walking, slow jogging exercise, and Proprioception exercises in beach sand (authors advised as precautions before entering into the sea), Indoor exercises like planks, wall squats, lunges, front walk, sidewalk. progression to Plyometric exercise 4th to 6<sup>th</sup> week. We monitor all exercise on video call; the authors advised any correction as the patient needs, they must have one helper or active family

member who can assist the patient—rehab protocol for ligament Tempo 3:1:1 Progress 1:0:1, Reps 6-8x, Sets 3-5x, Rest 1min.

**Group B Experimental Group** The authors advised the same thing as we mentioned above, group A exercises up to 1<sup>st</sup> week. After 2<sup>nd</sup> week onwards patient performed Xbox 360 Kinect video game. Before advising the video game, the patient have been instructed on the live mobile video mode and to take precautions like wearing sports shoes, enough water to hydrate, lite snacks before 1 hour to the exercise well-aerated room. The patient will perform the same type of exercise free exercise that we prescribe to group A free land exercise, front walking, back walking, slow jogging, and close chain exercise with the help of different CDs ('your shape fitness evolved' for hip abductor strengthening, lateral thigh muscle strengthening, stretching exercise, lunges, squat exercise purpose. 'Kinect adventures' for plyometric exercise, 'Kinect sports' for table tennis, slow running, football kicking, hoping, 'Kinect training' for lower limb exercise.)

**Fig. 1** Group A:  
**1<sup>st</sup> week exercises**



**2<sup>nd</sup> week exercises**



3<sup>rd</sup> week



4<sup>th</sup> & 5<sup>th</sup> week



6<sup>th</sup> Week



Fig. 2 Group B:

1<sup>st</sup> week



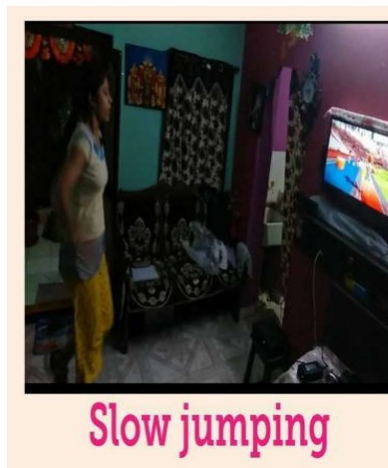
2<sup>nd</sup> week



3<sup>rd</sup> week



4<sup>th</sup> & 5<sup>th</sup> week



6<sup>th</sup> Week



## RESULTS

**Table 1: XBOX CONNECT 360.**

Games required	Exergaming Instruction	Mirror matched Instruction	Movements required
River Rush	Steering a cart along a track, avoiding obstacles by jumping and landing on two feet, squatting down, and using full body movements jumping from left to right to avoid barriers and collect points.	Jump up and down on the spot, taking off and landing in the same position (2 footed). In between jumping, perform a squat, keeping your back straight and not bent. Move your full body from left to right when instructed to do so as fast and safely as possible. Only under instruction from GB alternate the movements.	Full medial and lateral weight shifting. Vertical jumping and squatting low.
Target Kick	Kick virtual ball into the targets as many times as possible, standing on alternative legs to kick the ball.	Start in a normal neutral standing position, (two feet on the ground); alternatively produce kicking movements with each leg.	One legged standing with hip flexion and extension.
Reflex Ridge	Steering a cart along a track, avoiding obstacles by jumping and landing on two feet, squatting down, and using full body movements jumping from left to right to avoid barriers and collect points.	Jump up and down on the spot, taking off and landing in the same position (2 footed). In between jumping, perform a squat, keeping your back right and not bent. Move your full body from left to right when instructed to do so as fast and safely as possible. Only under instruction from GB alternate the movements.	Full medial and lateral weight shifting. Vertical jumping and squatting low.
Stomp it	Step on the boxes when the light ups right, left, front, diagonal, back	Foot clock drill	Hip abduction, adduction, flexion and extension. Multi- directional lunge drill for knee proprioception.

**Table 2: Rehab protocol.**

Duration	Target	Dosage	Target
1 <sup>st</sup> week after starting rehab	decreasing pain, swelling mobility exercises goal to reach the full ROM close chain exercises, core activation. Aquatic therapy	REPS 6-8x, Sets 3-5x, 1x 15min per day (in every 3 hours) 20sets /day	Tempo 3:1:1, Rest 1 min with movement (rest: work ratio!)
2 <sup>nd</sup> week	no swelling, Full ROM, maintain the endurance, close chain exercise, isolated strengthening with progressions, proprioceptive training, cortical training, balance training	Reps 6-8x, sets 3-5x	Tempo 3:1:1-2:1:1-1:1:1-1:0:1, Rest 1min
3 <sup>rd</sup> week	Strengthening With Progression, Running, Skipping, Forward Backward, Linear, 50-60% Load, Load Super Compensation	Reps 6-8x, sets 3-5x	tempo 1:0:1, rest 2-3min
4 <sup>th</sup> week	Plyometric training with progression, Running linear, lateral, interval training 60-70%.	Reps 6-8x, sets 3-5x	Tempo 0,5:0:0, Rest 2-3min.
5 <sup>th</sup> week	Plyometric training with progression (40% of max. load) running, fast stops, direction changes, interval running (70- 80%)	Reps 6-8x, Sets 3-5x	Tempo 0, 125:0:0, 125 rest 1-1.5min.
6 <sup>th</sup> week	Running. Sports specific exercises- football kicks, table tennis running etc. [20-22].	Reps 6-8x, sets 3-5x	tempo 0, 125:0:0, 125. rest :1-1.5min.

**Table 3:** Paired sample statistics.

		Mean	N	SD	Standard error mean	t value	p value
Pair 1	Pre KS-Post KS	39.31	13	4.385	1.216	32.31	<0.001**
Pair 2	Muscle girth Pre - Post at 1 cm	1.08	13	0.493	0.137	7.86	<0.001**
Pair 3	Muscle girth Pre - Post at 2 cms	2.77	13	0.438	0.122	22.77	<0.001**
Pair 4	Muscle girth Pre - Post at 3 cm	1	13	0.408	0.113	8.83	<0.001**
Pair 5	Muscle girth Pre - Post at 4 cm	2.92	13	1.441	0.399	7.31	<0.001**

**Table 4:** Paired sample test.

		Mean	Std. deviation	Standard error mean	95% confidence interval of the difference		t value	df	p value
					Lower	Upper			
Pair 1	Pre KS-Post KS	37.92	8.69	2.411	-43.18	-32.67	15.72	12	<0.001**
Pair 2	Muscle girth Pre - Post at 1 cm	0.92	0.28	0.077	0.76	1.09	12	12	<0.001**
Pair 3	Muscle girth Pre - Post at 2 cms	2.08	0.28	0.077	-2.24	-1.91	27	12	<0.001**
Pair 4	Muscle girth Pre - Post at 3 cms	1.08	0.28	0.077	-1.24	-0.91	14	12	<0.001**
Pair 5	Muscle girth Pre - Post at 4 cms	4.15	0.38	0.104	-3.93	-3.93	39.88	12	<0.001**

A total of 30 subjects were taken, but four subjects were excluded as their health does not permit so; the total number of subjects was 26, with 13 in Group A, which received traditional training, and 13 subjects which received Xbox Kinect 360 training.

Comparison of mean and standard deviation of subjects aged (18-25) between Group A (Traditional Training) and Group B (X box Kinect 360 Training). The mean age of Group A was 20.7143±1.98278, and that of Group B was 20.6571±2.21711, respectively. The paired t-test value was 15.728.

There was no significant difference between age groups. But both Kujala score and muscle girth scores with t value has been tabulated in table 1 & 2 with p-value <0.001\*\* (i.e., p <0.05 at 95 % confidence interval), so the pre- and post-values of Kujala score and muscle girth were statistically significant.

## DISCUSSION

This experimental study aimed to determine if the Xbox Kinect 360 could be an alternative

intervention in ACL Sprain rehabilitation during the Covid-19 lockdown pandemic. The result is not statistically significant compared to traditional rehab exercises, but the master chart and patient feedback reveal positive and better improvement. All patient's Kujala scales decreased in both experimental and conventional groups, and muscle girth developed increased in size within a 6-week span.

In both groups, participants experienced moderate to vigorous levels of exercise intensity (between 61 and 82 % HR max). Patients felt sweating even in air-conditioned rooms, exertion, and increase heart rate. Gillian Barry et al. (2016) support our study as participants also felt moderate to vigorous exertion.

Barry et al. found that young males achieved moderate intensity exercise [64-72 % HRmax] for exergaming using the XBOX Kinect™. The results indicate moderate-intensity exercise is achievable using the XBOX Kinect in young, healthy adults. Among these two groups, Xbox Kinect 360 group patients felt interested in

video games as they make interest to target reach as score and reward points/coins appear when players play the games on the screen. But the minus point in video games is that players felt hyperactive, leading to their chances of injury aggravating.

In Groups A and B, the first joint line (0 cm) area decreased muscle girth (the reason behind this swelling decreased after our intervention). Remaining 2<sup>nd</sup> (5cm), 3<sup>rd</sup> (10 cm), 4<sup>th</sup> (15 cm), etc., improved muscle girth. As exercise physiology says, when we do resistant and plyometric exercise, weight-bearing exercise micro breakdown happens in muscles leading to increase muscle area. Alicja Dziuba-S<sup>3</sup>onina (2018) supports our study as exercise and a protein diet improve muscle girth.

## CONCLUSION

Overall, our study has contributed to expanding the knowledge about the possible use of the Xbox Kinect 360 as a new rehabilitation tool for ACL sprain, especially in a home setting during any pandemic situation when patients are unable to go to physio clinic or rehab centers where the mass gathers chances of spread virus. In a society where the access time to a rehabilitation program is in constant increase and with an aging population at risk of falling, we can see the benefits in the future of a Kinect home-based program to improve Knee ACL Sprain conditions such as increased range of motion, gradual fun-based muscle strengthening, individual score increased interest to cross that score. Improvement of muscle bulk, and improved knee joint Proprioception. Comparing traditional treatments with or without adding extra Kinect 360 training sessions would be very interesting, being that it may be a good addition to the treatment for post-operative ACL rehab, ACL sprain conservative management, and maintaining Knee joint fitness when sports players in home without exposure of COVID-19.

**Conflicts of interest: None**

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