

**EFFECT OF ANTIGRAVITY TREADMILL TRAINING ON  
SELECTED SPATIOTEMPORAL PARAMETERS AMONG  
ATHLETES UNDERGONE ARTHROSCOPIC LIGAMENT  
OR MENISCUS REPAIR- A RANDOMIZED CONTROLLED  
TRIAL**

**By**

**SINGAMPALLI PRASAD**

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**In Partial Fulfilment  
Of the requirements for the degree of  
MASTER OF PHYSIOTHERAPY (MPT)  
In  
SPORTS**

**Under the Guidance of**

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**ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH  
INSTITUTE BHUBANESWAR, ODISHA - 2023-2025**

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I hereby declare that this dissertation/thesis entitled “**Effect of antigravity treadmill training on selected spatiotemporal parameters among athletes undergone arthroscopic ligament or meniscus repair – a randomized controlled trial**” is a bonafide and genuine research work carried out by me under the guidance of Dr. Deepak Kumar Pradhan (PT), ), Associate Professor and Co- Guide Dr. Anand Chandra Sahoo (PT), Assistant Professor, Abhinav Bindra Sports Medicine and Research Institute, Bhubaneswar, Odisha.

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Thank you.

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**Signature of the candidate**

**Singampalli Prasad**

## LIST OF ABBREVIATIONS USED

<b>Abbreviation</b>	<b>Full Form</b>
<b>ACL</b>	Anterior cruciate ligament
<b>EG</b>	Experimental group
<b>CG</b>	Control group
<b>VAS</b>	Visual analogous scale

## **ABSTRACT**

**Background:** The anterior cruciate ligament (ACL) is vital for maintaining knee stability by controlling both forward and rotational movements of the shin bone. It plays a key role during activities such as running, jumping, and sudden directional changes. Due to the high stresses placed on it, the ACL is one of the most commonly injured knee structures, especially among athletes. An injury often leads to instability, reduced performance, and a higher chance of developing issues like meniscus damage or early arthritis. These challenges emphasize the importance of effective rehabilitation strategies and advanced technologies to restore function and support a safe return to sport.

**Objective:** To evaluate the Effect of antigravity treadmill training on selected spatiotemporal parameters among Athletes undergone arthroscopic ligament or meniscus Repair.

**Methods:** Twenty subjects were assigned to: a experimental group (n=10) 9 training sessions, 3 sessions per week lasting for 5 minutes); an control group (n=10) 9 training sessions, 3 sessions per week. The outcome measure is Walker view treadmill.

**Results** significant difference in all three variables, Cadence was significantly higher in EG ( $15.4 \pm 3.06$ ) compared to CG ( $1.4 \pm 1.7$ ),  $t(df) = 12.618$ ,  $p < 0.001$ . Step length was greater in EG ( $20.3 \pm 4.64$ ) compared to CG ( $0.50 \pm 0.97$ ),  $p < 0.001$ . Stride length was also significantly higher in EG ( $11.8 \pm 2.20$ ) than in CG ( $0.10 \pm 0.316$ ),  $t(df) = 16.639$ ,  $p < 0.001$ .

**Conclusion:** The study shows that adding antigravity treadmill training to ACL and meniscus rehabilitation helps athletes recover their walking ability faster

than with standard physiotherapy alone. By reducing the load on the joints, the treadmill allows safe and early walking practice. This support helps athletes regain step length, stride, and walking rhythm more effectively, leading to a quicker return of normal gait patterns.

**Keywords:** ACL repair, Antigravity treadmill training, Meniscus repair, spatiotemporal parameters, traditional training,

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## **1. INTRODUCTION**

## **INTRODUCTION**

ACL tear is a commonest sports knee injury that occurs when one of the four major ligaments in the knee gets stretched, torn, or ruptured that involves sudden stops or change in direction while performing any sports like basketball, soccer, skiing or football. ACL plays important role in stabilizing the knee while controlling its forward movement and rotation of the tibia in relative to the femur and providing stability during dynamic movements (1,15). ACL repair can significantly impact on individual athletic performance and overall knee function. ACL repair is often pursued to restore knee stability and function, particularly in individuals who tend to return to high-demand physical activities and sporting activities (2,12). Due to these multiple functions get affected causing knee instability, loss of function, pain along with it there is long-term joint degeneration (3,11). This has estimated that there are about 100,000– 200,000 ACL injuries per year commonly in athletes which have particularly those involved in pivoting, jumping, or rapid deceleration sports. The clinical symptoms commonly observed after ACL repair are pain, swelling, stiffness, weakness followed by gait abnormalities and occasional instability (4,10).

Meniscal tears happen as the knee twists when the foot falls on the ground. This may occur by a sudden shift of direction, or by jumping upon landing. In sports meniscal injury is a frequent occurrence when an athlete bends his knee and then stands on his foot as he turns quickly or

makes a sudden stop or even lands. Such movements are typical in such sports as football, basketball and soccer (11,5). The injury may be through direct contact, e.g., a tackle, or none whatsoever, simply through abrupt change of direction.

One of the injuries among the athletes is the anterior cruciate ligament (ACL) injury that influences the stability when making quick turns, jumps and sudden stops. Quite often it is repaired surgically. In some cases, meniscus is also associated that influences the recovery process (6).

The treatment of meniscal injuries: repair, partial meniscectomy, or conservative treatment makes a significant difference to knee biomechanics and recovery (7). The decision to use surgery has an impact on the outcome of the healing process, and in case of colossal injury to the anterior cruciate ligament (ACL), post-traumatic osteoarthritis, which is one of the most severe complications, becomes a possibility.

One of the most important aspects of recovery after knee surgery is gait adaptation. The changes in walking mechanics may shift the load distribution inside the knee joint and usually augment or decrease the demands on the medial compartment. The imbalances can have a bad influence on the integrity of joints and increase degenerative alterations with time (8,11).

Gait biomechanics assessment after the various meniscal treatment strategies in combination with anterior cruciate ligament (ACL) reconstruction can clarify the results of why functional recovery is variable. Although certain patients recover close-to-normal kinematics,

others acquire the mal-adaptive loading patterns, which enhance the medial compartment load and long-term potential of joint degeneration. These lessons are important to streamline surgical plans and rehabilitation regimens to achieve long-term knee performance and stability.

The anti-gravity treadmill can be considered a rehabilitation aid because it allows people to walk or run on lower limbs with reduced weight. This is what makes it particularly helpful to individuals with neurological problems, and also to those who were just coming out of orthopaedics surgeries such as knee replacement and ligament repair (9). By reducing the effect of small impact on their joints, patients start walking the day sooner in their recovery and do not overload the surgical site. Weight on it produces a significant advantage, which is pain relief. It is painful to make a patient walk after surgery or maintain their balance (10).

Sports-related injuries are highly prevalent, particularly among athletes engaged in contact sports. The knee joint is one of the most susceptible anatomical structures, with injuries such as ACL ruptures and meniscal tears reported frequently in both amateur and professional athletes (11,2)). These injuries not only impair functional performance but also have the potential to reduce overall athletic participation and career longevity. Furthermore, appropriate rehabilitation protocols and comprehensive medical care are critical determinants in facilitating a safe and effective return to sport. The implementation of structured rehabilitation programs plays a pivotal role in restoring joint stability, preventing re-injury, and enabling athletes to sustain long-term involvement in their respective sporting activities (12,5) Antigravity treadmill Training is one of the

arising modalities to promote the early rehabilitation of this vulnerable injuries. In this it reduces the joint stress by reducing body weight loading on lower limbs, enabling to promote gait training rehabilitation (13). This modality calibrates and lifts the body partially by air pressure by this it ssreduces ground reaction forces acting on lower limbs. But due to dearth of literature on effect of antigravity treadmill training on selected spatiotemporal parameters among arthroscopic ligament or meniscus repair athletes is not known (14). So, we designed this research to evaluate the effects on selected spatiotemporal parameters in athletes.

## **2. AIM & OBJECTIVE OF THE STUDY**

### **AIM OF THE STUDY**

To evaluate the effect of antigravity treadmill training on selected spatiotemporal parameters among athletes undergone arthroscopic ligament or meniscus repair.

### **OBJECTIVE OF THE STUDY**

To find out effects of antigravity treadmill training on selected spatiotemporal parameters among athletes undergone arthroscopic ligament.

To find out effects of antigravity treadmill training on selected spatiotemporal parameters among athletes undergone meniscus repair.

### **3. HYPOTHESIS OF THE STUDY**

## **HYPOTHESIS OF THE STUDY**

**Null Hypothesis:** It is hypothesized antigravity treadmill training on selected spatiotemporal parameters would exhibit no significant improvement among athletes undergone arthroscopic ligament or meniscus repair.

**Alternate Hypothesis:** It is hypothesized antigravity treadmill training on selected spatiotemporal parameters would exhibit significant improvements among athletes undergone arthroscopic ligament or meniscus repair.

#### **4. REVIEW OF LITERATURE**

## REVIEW OF LITERATURE

**Greig M et al. (2023)** This case study of a professional soccer player 4 weeks post-medial meniscectomy (8 months after ACL reconstruction) used tri-axial accelerometry during anti-gravity treadmill running at 70-95% bodyweight. The study identified discrete loading progressions at 70% and 85% bodyweight, with bilateral asymmetry evident in the medio-lateral plane despite vertical symmetry. The affected limb showed lower medio-lateral acceleration at touchdown but greater Player Load during foot contact in all planes, highlighting the importance of multi-planar analysis in rehabilitation assessment rather than traditional vertical plane analysis alone.

**Vincent HK et al. (2022)** This comprehensive review article examined the biomechanical and metabolic changes during body weight support treadmill training and its effects on clinical outcomes in injured runners. The review found that antigravity treadmills cause reductions in cadence, ground reaction forces, knee and ankle range of motion, and vertical stiffness, while increasing stride duration and flight time. The technology appears useful across various running injuries including osteochondral defects, stress reactions, and lumbar disc herniation, allowing runners to preserve aerobic fitness and muscle activation patterns during recovery compared to traditional rehabilitation protocols.

**Abdelaal A and El-Shamy S.(2022)** This randomized controlled trial studied 45 males with diabetic polyneuropathy, comparing antigravity treadmill training (75% weight bearing, 30 minutes, 3x/week for 12 weeks) plus traditional therapy versus traditional therapy alone. The experimental group

showed significantly greater improvements in spatiotemporal gait parameters and postural stability indices compared to controls, with post-treatment improvements in step length (61.3 vs 56.14 cm), velocity (83.09 vs 75.73 cm/sec), and overall stability index (0.32 vs 0.70), demonstrating antigravity treadmill effectiveness for diabetic neuropathy rehabilitation.

**Palke L et al. (2021)** This randomized controlled trial involving 73 patients (37 intervention, 36 control) compared one-year outcomes of anti-gravity treadmill rehabilitation versus standard rehabilitation for ankle or tibial plateau fractures. While no significant differences were found in primary endpoints (FAOS/KOOS scores), patients who underwent anti-gravity treadmill rehabilitation showed better gait performance measured by Dynamic Gait Index and less muscle atrophy, particularly in tibial plateau fracture patients who had 3 cm wider thigh circumference compared to controls. The study demonstrates long-term benefits of anti-gravity treadmill training for specific outcome measures.

**Bravi M et al. (2021)** This validation study with 17 healthy participants tested the WalkerView instrumented treadmill against a motion capture system at three walking speeds (3, 5, and 6.6 km/h). The study demonstrated that WalkerView is valid for analysing spatiotemporal parameters (excellent ICC for step time, cadence, and step length: 0.502-0.996) and hip total range of motion (fair to excellent agreement at 3 km/h: 0.579-0.735). However, knee ROM and kinematic peak values showed lower agreement levels, indicating the need for careful evaluation of these specific parameters.

**.Zielinski MC et al. (2019)** This laboratory-controlled study analyzed knee biomechanics in 5 post-ACL reconstruction athletes compared to 10 healthy controls during normal walking, cutting, and weaving movements using motion analysis and force plates. While no statistically significant differences were found between reconstructed and contralateral knees during walking ( $p=0.27-0.49$ ), ACL reconstructed knees showed increased rotation during cutting movements ( $21.82^\circ$  vs  $11.29^\circ$ ,  $p=0.175$ ), suggesting persistent subtle gait alterations despite successful rehabilitation, though the small sample size limited statistical power.

**Huang CH et al. (2018)** This case series examined four females who underwent unicompartmental knee arthroplasty (UKA) and participated in antigravity treadmill training three times per week for 12 weeks in addition to standard physical therapy. The study found that peak knee flexion and peak knee extensor moment during weight acceptance increased to normal values following the intervention ( $14.1 \pm 6.5^\circ$  to  $20.6 \pm 1.5^\circ$  and  $0.4 \pm 0.3$  to  $0.7 \pm 0.2$  Nm/kg respectively). The findings suggest that incorporating early gait training using an antigravity treadmill may be beneficial in eliminating "quadriceps avoidance" during early rehabilitation following UKA.

**Capin JJ et al. (2018)** This secondary analysis of 61 athletes post-ACL reconstruction examined gait mechanics based on concurrent medial meniscal treatment (none, partial meniscectomy, or repair). Using comprehensive walking analysis and musculoskeletal modeling, the study found that partial meniscectomy patients walked with higher peak knee adduction moments and increased medial compartment loading, while meniscal repair patients demonstrated opposite patterns with reduced loading, suggesting different

biomechanical adaptations that may influence long-term osteoarthritis risk depending on meniscal treatment approach.

**.Brown J et al. (2015)** This randomized controlled study compared 15 ACL reconstruction patients allocated to either AlterG (n=7) or traditional rehabilitation (n=6) groups. At 12 weeks, the AlterG group showed significantly higher KOOS sub-scores for pain, symptoms, and quality of life compared to traditional rehabilitation, with the AlterG group achieving control-like parameters while the traditional group still differed from controls in several measures. Despite the AlterG group having more complex surgical procedures, they demonstrated faster functional recovery, suggesting the technology's effectiveness in ACL rehabilitation.

**Gokeler A et al. (2013)** This systematic review analysed 22 studies including 479 ACL reconstruction patients (mean age 27.3 years) to comprehensively evaluate kinematic and kinetic variables during gait post-surgery. The review found persistent gait alterations in sagittal, frontal, and transverse planes that can last up to 5 years post-surgery, with reduced knee flexion range of motion and altered knee extension moments being most consistently reported, emphasizing that current rehabilitation techniques should be examined to minimize long-term biomechanical changes that potentially contribute to osteoarthritis development.

**Hall M et al. (2012)** This cross-sectional study compared lower extremity gait patterns during walking and stair negotiation between 15 individuals >1-year post-ACL reconstruction and 17 healthy controls, focusing on osteoarthritis risk factors. ACL participants demonstrated reduced initial knee flexion angles

during stair descent, reduced knee extension moments during stair activities, and increased hip extension moments during walking and stair ascent, suggesting compensatory movement strategies that may contribute to altered joint loading and potential osteoarthritis development through modified cartilage loading patterns.

**Lewek MD et al. (2011)** This biomechanical study investigated how body weight support (BWS) systems alter ankle plantar flexor mechanics during treadmill locomotion across different speeds and unweighting levels (0%, 20%, 40% BWS). Fifteen unimpaired participants underwent gait analysis revealing that at slower speeds, BWS had minimal impact on propulsive forces, but at speeds  $\geq 0.8$  m/s, increased BWS significantly reduced plantar flexor moments and ankle power generation while muscle activity remained unchanged, suggesting BWS may be beneficial for training at higher speeds without overloading compromised plantar flexors

## **5. METHODOLOGY & PROCEDURE**

## **METHODOLOGY & PROCEDURE**

- **STUDY POPULATION:** Athletes
- **STUDY DESIGN:** Randomized control trial
- **SAMPLING TECHNIQUE:** Universal sampling
- **SAMPLE CRITERIA:**

### **INCLUSION CRITERIA:**

1. Male and female athletes
2. Age group 15-30 years
3. Knee ROM more than 90 degrees

### **EXCLUSION CRITERIA:**

1. Unhealed surgical incisions
  2. Severe pain
  3. Knee fracture
- **STUDY SETTING:** Private rehabilitation Centre, Bhubaneswar  
Odisha
  - **SAMPLE SIZE:** 20
  - **STUDY DURATION:** 1 year
    - **Ethical clearance:** 6 months

- **Sample selection, data collection:** 4 months
- **Statistical analysis, results analysis, discussion:** 2 months.

➤ **MATERIALS USED:**

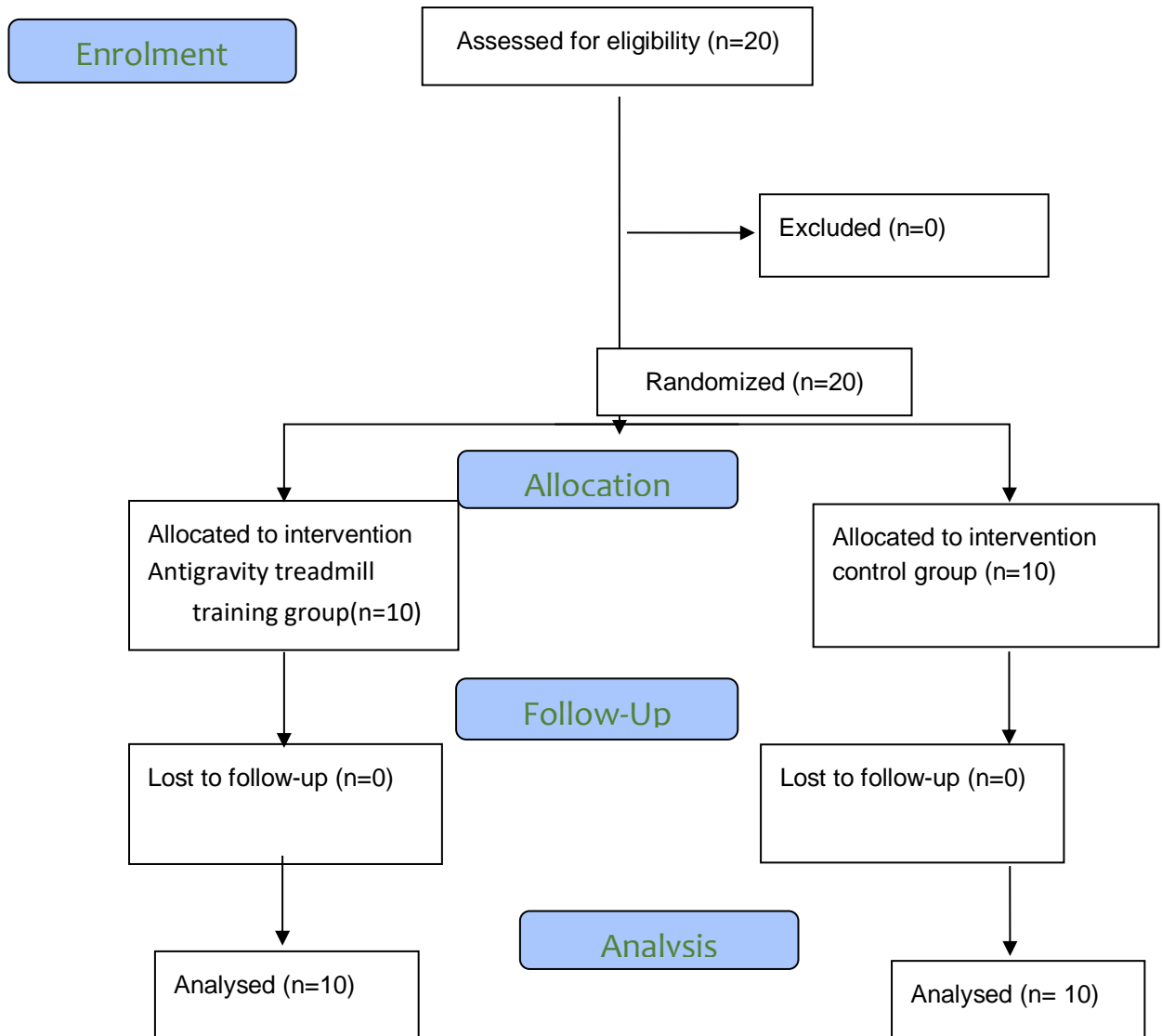
- Foam roller
- Thera band

➤ **OUTCOME MEASURES:**

Walker view treadmill

- Cadence
- Step length
- stride length

## FLOW CHART



## **PROCEDURE**

The present study was reviewed and approved by institutional ethical committee Abhinav Bindra Sports Medicine and Research Institute (ABSMARI), Pahal, Bhubaneswar.

A randomized trial was performed at Private rehabilitation Centre, Bhubaneswar Odisha

The total 20 samples were selected by using purposive sampling based on inclusion and exclusion criteria. They were included in this study with some criteria like athletes who were undergone ACL or Meniscal repair. The demographic data of the participants was taken like age, after surgery.

Before test, the VAS scale will be taken to assess pain severity, if the participants reported pain of more than 5 on a VAS, then antigravity treadmill training will be given.

Then knee range of motion will be measured through goniometer for accurate measurement, if knee range of motion is more than 90 degrees then we will proceed with the training.

Then the study protocol was explained to all the participants and informed consent was obtained from all the participants.

The group allocation was done by using simple randomization by block random.

There were 2 groups in which 10 of each A, B, where A= Experimental group, B= Control group.

All the participants were explained about the tests and exercises they would have to perform over a time period of 3weeks.

(Group A) Antigravity treadmill training (3 days per week for 3 weeks) which includes Warm up = 4-7 min, Anti-gravity treadmill training = 5 min. Cool down = 3min.

(Group B) which is Control group will undergo any Traditional training protocols there were exercise for all 3 weeks.

All the exercise were performed under the therapist observation. After 3 weeks. All Pre & post spatiotemporal parameters by the use of walker view (tecno body treadmill) the pre- and post- exercise values were recorded and excel sheet was maintained.

### **Traditional Training + Antigravity Treadmill Training**

- Traditional Training
- Antigravity treadmill training for 3weeks including 9 sessions.
- Speed:1 mph for 3days  
2 mph for 3days  
3 mph for 3days
- Body weight: 30%
- Time: 5 minutes
- Pre & post spatiotemporal parameters have taken by the use of walker

view.

- **Antigravity Treadmill Training**

- Antigravity treadmill training for 3weeks including 9 sessions.

- Speed:1 mph for 3days

2 mph for 3days

3 mph for 3days

- Body weight: 30%

- Time: 5 minutes

- Pre & post spatiotemporal parameters have taken by the use of walker

view.



Fig 1. Walker view treadmill



Fig 2. Vmo strengthening



Fig 3. Foam rolling



Fig 4. Antigravity Treadmill Training

6. **STATISTICAL ANALYSIS**

## **STATISTICAL ANALYSIS**

Statistical analysis was done using SPSS version 22. The Shapiro wilk test was used to assess the normality of data. All the variables were normally distributed because the p value  $>0.05$ . Independent t- test was used for between group and paired t test was used for within group.

## 7. RESULTS

## **RESULTS AND INTERPRETATION**

In the present study, 20 Athletes those who have ACL and Meniscal repair were recruited. All participants completed the study protocol, and the data were analyzed. The analyses were conducted at a significant i.e.,  $p < 0.05$  level of 0.05 (95% confidence level).

### **BASELINE DATA**

#### **Demographic details**

The EG consisted of 10 participants with ACL and meniscal repair with mean age ( $22.8 \pm 4.541$ ) years. The CG consisted of 10 participants with ACL and meniscal repair with mean age ( $21.9 \pm 1.852$ ) years.

### **FINDING THE NORMALITY**

The EG age p value is (0.48) and CG age P value is(0.47), which were statistically significant ( $P > 0.05$ ), indicating normal distribution of the data.

The p value of cadence, step length, and stride length of both Experimental group and Control groups ( $p \text{ value} > 0.05$ ), indicating normal distribution of the data .**Test of Normality**

**Table-1**

Variables	EG Mean (SD)	P-value	CG Mean (SD)	P-value
Age	22.8±4.541	.048	21.9±1.852	.407
Cadence pre	89.4±4.599	.09	86±3.33	.390
Step length pre	44±4.618	.172	46.7±4.448	.884
Stride length pre	46.3±3.056	.120	45.1±3.813	.307

## **INFERENCEAL STATISTICS**

### **With in-group comparison**

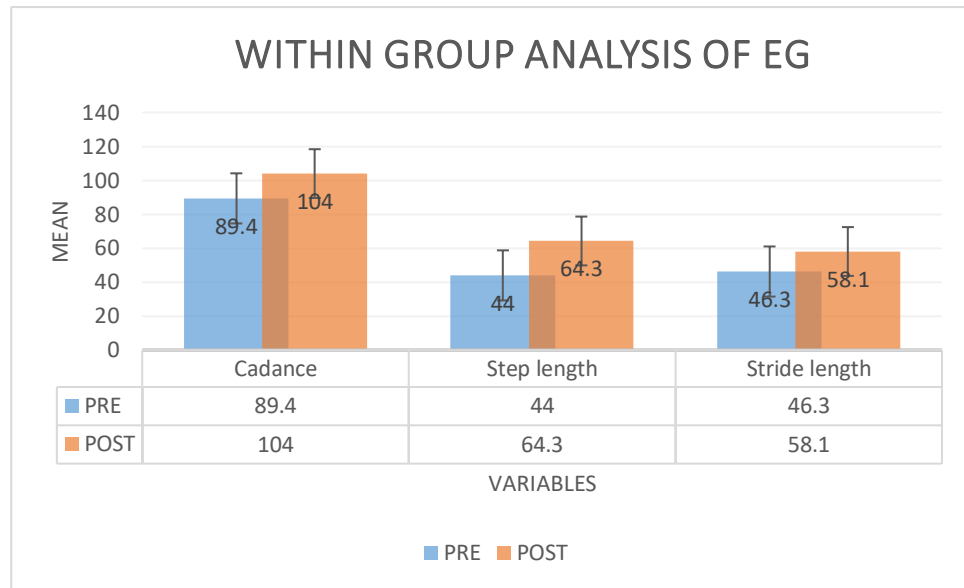
#### **Paired t-test result**

The statistical analysis for the EG (n=10) showed significant improvements across all outcome measures following. Paired-samples t-tests revealed that post-intervention scores were significantly higher than pre-intervention scores for the cadence ( $p < .000$ ), step length ( $p < .000$ ), stride length ( $p < .000$ ), all indicating large effect sizes. The mean differences were -15.4, -20.3, -11.8, respectively, confirming clinically meaningful gains. These findings demonstrate that Antigravity treadmill training and conventional training produced significant improvements within the EG.

#### **Within group analysis of EG**

**Table-2.1**

Variables	PRE	POST	Mean Difference	t	p
	Mean (SD)	Mean (SD)			
Cadance	89.4±4.599	104±3.293	-15.4	-15.903	.000
Step length	44±4.618	64.30±3.056	-20.3	-13.823	.000
Stride length	46.3±3.056	58.1±1.449	-11.8	-16.954	.000



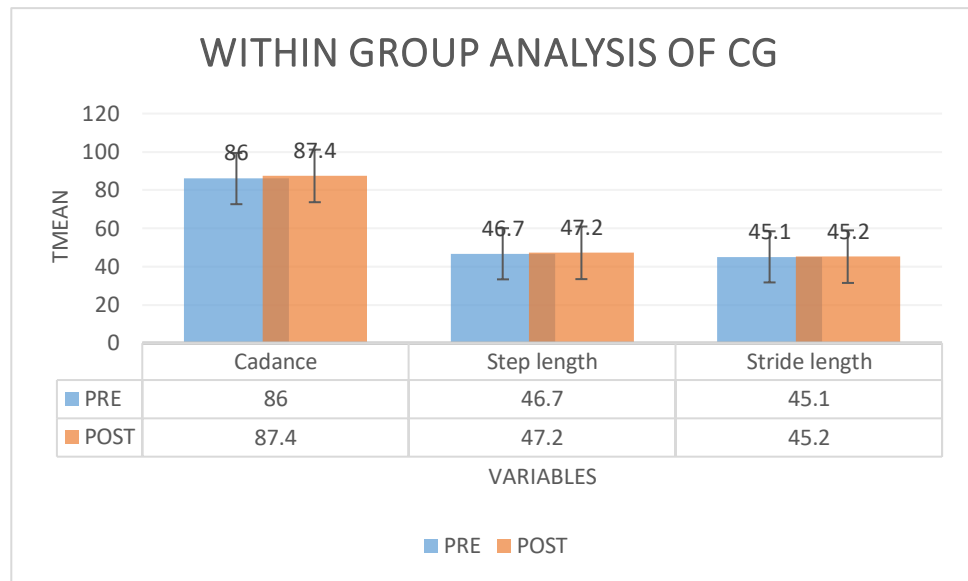
**GRAPH 1**

The statistical analysis for the CG (n=10) showed significant improvements across all outcome measures following. Paired-samples t-tests revealed that post-intervention scores were significantly higher than pre-intervention scores for the cadence ( $p < .029$ ), step length ( $p < .138$ ), stride length ( $p < .343$ ). The mean differences were -1.4, -.5, -.1, respectively, confirming the clinically meaningful gains. These findings demonstrate that conventional training produced significant improvements in cadence within the CG.

### **Within group analysis of CG**

**Table-2.2**

Variables	PRE	POST	Mean Difference	t	p
	Mean (SD)	Mean (SD)			
Cadance	86±3.33	87.4±3.339	-1.4	-2.585	.029
Step length	46.7±4.448	47.2±4.077	-.5	-1.627	.138
Stride length	45.1±3.813	45.2±3.794	-.1	-1	.343



**GRAPH 2**

**BETWEEN GROUP ANALYSIS**

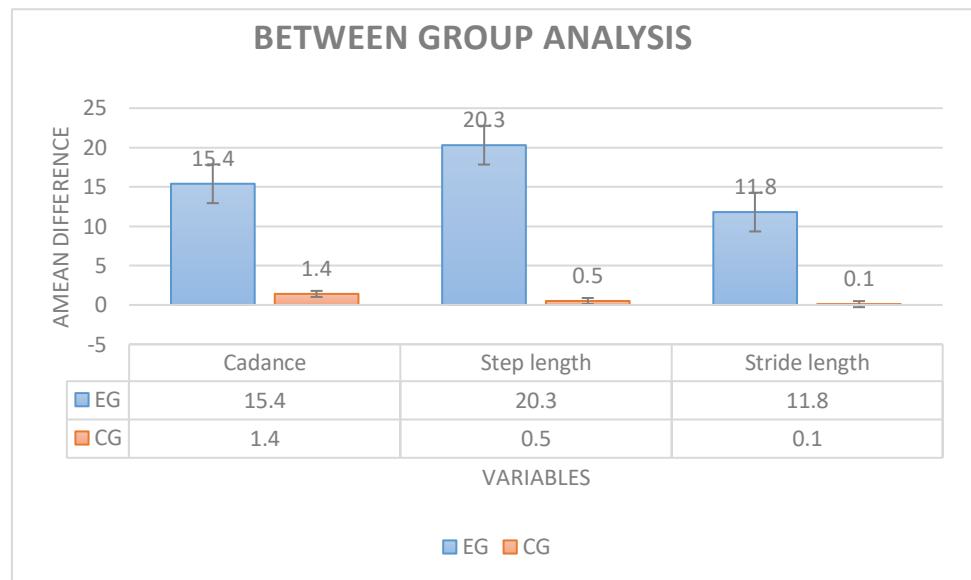
**Independent t-test**

Independent t-test was conducted to compare gait parameters between the experimental group (EG) and the control group (CG). The results showed a statistically significant difference in all three variables, Cadance was significantly higher in EG ( $15.4 \pm 3.06$ ) compared to CG ( $1.4 \pm 1.7$ ),  $t(df) = 12.618$ ,  $p < 0.001$ . Step length was greater in EG ( $20.3 \pm 4.64$ ) compared to CG ( $0.50 \pm 0.97$ ),  $p < 0.001$ . Stride length was also significantly higher in EG ( $11.8 \pm 2.20$ ) than in CG ( $0.10 \pm 0.316$ ),  $t(df) = 16.639$ ,  $p < 0.001$ .

These findings confirm that the experimental group demonstrated significantly better gait performance than the control group across all parameters.

Table:2.3

Variables	Group-1 EG	Group-2 CG	t	P-value
	Mean (SD)	Mean (SD)		
Cadance	15.4 ± 3.06	1.4 ± 1.7	12.618	0.00
Step length	20.3±4.64	.50±.97	13.197	0.00
Stride length	11.8±2.20	.10±.316	16.639	0.00



**GRAPH 3**

## **8.DISCUSSION**

## **DISCUSSION**

Rehabilitation after anterior cruciate ligament (ACL) and meniscus repair remains a demanding process for both athletes and clinicians. These injuries disrupt the normal biomechanics of the lower limb, limit mobility, and often diminish an athlete's confidence, all of which delay their return to sport. Although conventional rehabilitation programs are effective, they typically postpone the reintroduction of dynamic gait activities to avoid overloading the healing tissues. With the advent of newer technologies, particularly the antigravity treadmill, there is now an opportunity to begin gait retraining earlier while minimizing stress on the surgical site. The present study explored how this innovative approach influences spatiotemporal gait parameters in athletes recovering from arthroscopic ACL and meniscus repair, addressing an important gap in sports rehabilitation practice.

The purpose of this randomized controlled trial was to assess whether antigravity treadmill training could offer measurable advantages over standard rehabilitation methods. Athletes are often eager to resume activity quickly, yet their recovery must balance protection of the joint with progressive functional loading. This study is novel in that it examined the use of antigravity treadmill training during the early rehabilitation period in an athletic group. By reducing effective body weight during walking, the treadmill provided a safe environment to rehearse gait mechanics at an earlier stage than would normally be possible, offering a progressive but protective strategy compared with conventional care.

The statistical results strongly support the effectiveness of this approach. Within the experimental group, highly significant improvements were observed in cadence, step length, and stride length, with all  $p$ -values well below 0.001. These gains were not only statistically robust but also clinically meaningful, indicating a real impact on functional recovery. In contrast, the control group showed only modest improvements, with significance reached for cadence alone, while changes in step and stride length were minimal. Direct comparison between groups confirmed the superiority of the experimental intervention, with large  $t$  values and extremely low  $p$  values across all measures. These findings provide convincing evidence that antigravity treadmill training outperforms conventional rehabilitation for restoring functional gait parameters.

The physiological basis for these outcomes can be understood through the principle of partial body-weight support. By unloading a portion of the body's weight, the antigravity treadmill allows earlier, safer, and more frequent practice of walking without compromising the healing structures. This prevents the development of compensatory movement patterns and encourages more natural biomechanics. Repeated practice under these conditions enhances neuromuscular coordination and engages central pattern generators, which are key to rhythmic walking. Previous studies lend support to these findings: Grabowski and Kram reported improvements in gait mechanics with body-weight-supported treadmill use, while Patil and colleagues demonstrated faster recovery in orthopedic patients using similar methods. Taken together, the present results and past literature suggest that the combination of reduced joint stress, increased confidence, and repetitive

practice accounts for the superior outcomes in the experimental group.

Explained simply, athletes who used the antigravity treadmill were able to regain their normal walking pattern sooner than those who underwent conventional physiotherapy alone. The treadmill essentially makes the user feel lighter, reducing the strain on the injured knee and allowing smoother, longer steps. This early and safe practice helped athletes recover their walking rhythm more quickly and with greater confidence. While the control group showed slight improvements, the progress was small in comparison. The experimental group, on the other hand, demonstrated substantial gains in all gait measures, suggesting that the antigravity treadmill gave them a clear advantage in their recovery journey. Despite these encouraging outcomes, a few limitations should be acknowledged. The sample size was relatively small, with only twenty participants, which restricts how widely the findings can be applied. The follow-up period was also short, so the long-term effects on return-to-sport readiness, reinjury risk, or sustained improvements could not be determined. Furthermore, the study focused solely on spatiotemporal parameters and did not include other important aspects such as joint kinematics, muscle activation, or patient-reported outcomes. Future research should include larger samples, extended follow-up, and broader measures to capture a more comprehensive picture of recovery. It would also be valuable to examine cost-effectiveness and the feasibility of making antigravity treadmill training more widely accessible. Even with these limitations, the present study provides strong evidence that antigravity treadmill training can accelerate gait recovery in athletes after ACL and meniscus repair, making it a promising addition to modern sports rehabilitation practice.

## 8. CONCLUSION

## **CONCLUSION**

The present study provides clear evidence that adding antigravity treadmill training to rehabilitation following arthroscopic ACL and meniscus repair leads to faster and more meaningful improvements in gait compared to conventional physiotherapy alone. Athletes who trained with body-weight support regained cadence, step length, and stride length more effectively, showing that this method can accelerate the recovery of natural walking patterns. The benefit appears to stem from the treadmill's ability to reduce joint loading, enabling earlier and safer practice of walking while maintaining proper biomechanics and coordination.

Although the relatively small sample size and short follow-up restrict the wider application of these findings, the results strongly indicate that antigravity treadmill training offers a valuable supplement to traditional rehabilitation. Further research with larger groups, longer monitoring, and broader outcome measures—such as return-to-sport readiness and quality of life—would help strengthen the evidence base. Even so, this study highlights the potential of the antigravity treadmill as a modern rehabilitation tool that supports both safe tissue recovery and early functional mobility in athletes.

**9. LIMITATION**

## **LIMITATION**

Despite the promising findings, several limitations of the study need to be acknowledged.

1. Limited sample size – The study included only twenty athletes, with ten participants in each group, which may reduce the strength of the statistical analysis and limit the ability to generalize the findings to the broader athletic population.
2. Short duration of follow-up – Outcomes were assessed only during the early stages of rehabilitation, without evaluating long-term effects such as sustained gait improvements, return-to-sport readiness, or risk of reinjury.

## **CONFLICT OF INTEREST STATEMENT**

No potential conflict of interest was reported by the author(s). The authors alone are responsible for the content and writing of this thesis.

**10. STATEMENT OF FUNDING**

## **FUNDING**

The author(s) reported that no Outside funding was associated with the work featured in this thesis. The author(s) declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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**12.ANNEXURES**

**ANNEXURE 1**

**CONSENT FORM**

**Study Title:** Effect of antigravity treadmill training on selected spatiotemporal parameters among Athletes undergone arthroscopic ligament or meniscus Repair- A Randomized Controlled Trial

**Study Number:**

**Subject 's Name:**

**Date of Birth / Age:**

**Address of the Subject:**

**Qualification:**

**Occupation:**

- (i) I confirm that I have read and understood the information sheet dated for the above study and have had the opportunity to ask questions.
- (ii) I understand that my participation in the study is voluntary and that I am [ ] free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.
- (iii) I understand that the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted

in relation to it, even if I withdraw from the trial. I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published.

(iv) I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s)

(v) I agree to take part in the above study.

**Signature of subject**


**Signature of investigator**

**Signatory's Name:**

**Study investigator Name:**

**Date:**

## ANNEXURE 2



# ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,  
BHUBANESWAR, ODISHA

CDSCO Reg. No.: ECR/1981/Inst/OD/24

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Prof. (Dr.) E. Venkata Rao  
ChairpersonMr. Chinmaya Kumar Patra  
Member Secretary

---

Ref. No. ABSMARI/IEC/2025/190Date: 14/05/2025

**APPROVAL LETTER**  
**APPENDIX- VIII**

To,

**MEMBERS**

**Dr. Smaraki Mohanty**  
Clinician

**Dr. Satyajit Mohanty**  
Scientific Member

**Mr. Shib Shankar Mohanty**  
Legal Expert

**Ms. Annie Hans**  
Social Scientist

**Ms. Subhashree Samal**  
Lay Person

**Mr. Deepak Ku. Pradhan**  
Scientific Member

**IEC-SECRETARIAT**

**Mr. Gouranga Ku. Padhy**  
**Mr. Susant Ku. Raychudamani**

**SINGAMPALLI PRASAD**  
ABSMARI  
273, PAHAL, BHUBANEWAR-752101

**Protocol Title:** Effect of antigravity treadmill training on selected spatiotemporal parameters among Athletes undergone arthroscopic ligament or meniscus Repair- A Randomized Controlled Trial

**Protocol ID.:** ABS-IEC-2025-PHY-077


**Subject:** Approval for the conduct of the above referenced study

Dear **Mr./Ms./Dr Singampalli Prasad**  
With reference to your Submission letter dated 06/01/2025 the ABSMARI IEC has reviewed and discussed your application for conduct of the study on dated 26/04/2025.




The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	26/04/2025
2	Informed Consent Form	26/04/2025
3	Undertaking form PI	26/04/2025
4	CRF	26/04/2025
5	COI from the Investigators	26/04/2025


The following members were present at meeting held on 26-04-2025



1

 **Utkal Signature, Plot No.-273,  
Ground Floor, Pahal, Bhubaneswar-752101** **+91-63707-03654** **iec@absmari.com**

### ANNEXURE 3



## ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,  
BHUBANESWAR, ODISHA  
CDSCO Reg. No.: ECR/1981/Inst/OD/24

Prof. (Dr.) E. Venkata Rao  
Chairperson

Mr. Chinmaya Kumar Patra  
Member Secretary

Ref. No. ABSMARI/IEC/2025/190

Date: 14/05/2025

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
3	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
4	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
5	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Srilanka). /MA in Social Work	Social Scientist	F	N
6	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
7	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

**MEMBERS**

**Dr. Smaraki Mohanty**  
Clinician

**Dr. Satyajit Mohanty**  
Scientific Member

**Mr. Shib Shankar Mohanty**  
Legal Expert

**Ms. Annie Hans**  
Social Scientist

**Ms. Subhashree Samal**  
Lay Person

**Mr. Deepak Ku. Pradhan**  
Scientific Member

**IEC-SECRETARIAT**

**Mr. Gouranga Ku. Padhy**  
**Mr. Susant Ku. Raychudamani**

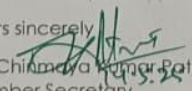
This is to confirm that only members who are independent of the investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

**This Committee approves the documents and the conduct for the study in the presented form with necessary recommendation.**


The ABSMARI IEC must be informed about the progress of the study in the prescribed format attached, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent/assent and request to provide a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

Yours sincerely,



Mr. Chinmaya Kumar Patra  
Member Secretary  
ABSMARI Ethics Committee  
Pahal, Bhubaneswar  
Member Secretary  
ABSMARI ETHICS COMMITTEE



2

📍 Utkal Signature, Plot No.-273,  
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**ANNEXURE 4**  
**MASTER CHAT**

Sr. No.	Name	Age/Gender	cadence		step length	
			Pre	Post	Pre	Post
1	Dharma		85steps	93 steps	40 cm	63 cm
2	Anurag kanojia		90 steps	98 steps	48 cm	65 cm
3	saurath kanojia		88 steps	95steps	40 cm	60 cm
4	Hupi mathi		95 steps	102steps	52 cm	62 cm
5	Pradeep kanhar		85 steps	95 steps	50 cm	68 cm
6	Manisha Oram		90 steps	100 steps	43 cm	65 cm
7	Malati Tudu		99 steps	107 steps	45cm	69 cm
8	Alok kumar		90 steps	101 steps	39 cm	66 cm
9	Narayana Sahu		87 steps	99 steps	40 cm	60 cm
10	archana xalno		85 steps	100 steps	43 cm	65 cm

Sr. No.	Name	Age/Gender	cadence		step length		stride length	
			Pre	Post	Pre	Post	Pre	Post
1	Hmahammad Anas		90 steps	106 steps	42cm	64 cm	44 cm	54 cm
2	Ajit kumar		86 steps	104 steps	52cm	65 cm	40 cm	52 cm
3	Joshoda bhoi		80 steps	101 steps	45cm	62 cm	45 cm	50 cm
4	Tarulata Naik		85 steps	111 steps	50cm	64 cm	50 cm	53 cm
5	Jagdis behera		83 steps	104 steps	46 cm	66 cm	42 cm	50 cm
6	Putin		80 steps	111	52 cm		51 40 cm	52
7	Debasis		89 steps	112	50 cm		60 44 cm	51
8	Subhashini		86 steps	110	48 cm		64 52 cm	54
9	Pratima		83 steps	101	40 cm		60 48 cm	52
10	Behru		85 steps	101 steps	45 cm	65 cm	40 cm	52 cm
11	mama		87 steps	103 steps	44 cm	61 cm	47 cm	55 cm
12	Ishmeet		90 steps	106 steps	49 cm	59 cm	44 cm	53 cm
13	Pitabas		84 steps	102 steps	40 cm	60 cm	49 cm	51 cm
14	Subhankar Pradhan		90 steps	101 steps	54 cm	64 cm	50 cm	50 cm

# ANNEXURE 5

S. Prasad

## EFFECT OF ANTIGRAVITY TREADMILL TRAINING ON SELECTED SPATIOTEMPORAL PARAMETERS AMONG ATHLETE...

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S. Prasad

## EFFECT OF ANTIGRAVITY TREADMILL TRAINING ON SELECTED SPATIOTEMPORAL PARAMETERS AMONG ATHLETE...

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