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The Domino Effect: Influence of Hip Flexibility on Ankle Stability and Game Performance of Basketball Players

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Introduction- Basketball is a dynamic and widely played team sport that demands a high level of physical skill, including dribbling, passing, shooting, defense, and rebounding. These activities require not only athleticism but also precise coordination and teamwork. Among the most common injuries in basketball are ankle sprains, which often result from poor joint stability. Investigating how deficits in hip flexibility may cascade into compromised ankle stability is essential for both injury prevention and optimizing athletic performance.

The aims of study- To assess the impact of limited hip flexibility on ankle stability in basketball players during game-specific movements. This observational study was conducted on basketball players to examine the relationship between hip flexibility and ankle stability.

Methodology- A total of 50 participants who met the inclusion criteria were selected for the study. Hip flexor tightness was assessed using the Thomas Test, a widely recognized clinical evaluation. In this test, the participant lies supine on an examination table and actively flexes one hip, pulling the knee toward the chest using both hands. The examiner observes the position of the contralateral leg. A positive test result—indicated by the thigh of the opposite leg lifting off the table—suggests tightness in the hip flexors. Ankle stability was evaluated using the Cumberland Ankle Instability Tool (CAIT), a validated questionnaire comprising nine items. The CAIT assigns a total score ranging from 0 to 30, with lower scores reflecting greater ankle instability and more pronounced functional impairment. This dual-assessment approach allows for a comprehensive analysis of how hip flexor tightness may influence ankle joint stability in basketball players.

Result- The study revealed that 29 participants had ankle instability on the same side as hip tightness, with 46 showing severe instability. The study found that 58% of basketball players aged 18–25 with limited hip flexibility also had ankle instability affecting the same ankle.

Key Words- Domino effect, Kinetic chain, Compensatory movement.

I. Introduction

Basketball is a high-intensity sport that requires a combination of strength, agility, balance, and flexibility, particularly in the lower extremities. Movements such as jumping, pivoting, rapid changes in direction, and landing from jumps place significant demands on both ankle stability and hip joint flexibility. Lower extremity injuries are common in basketball, with ankle sprains being among the most prevalent due to the sport's dynamic and high-impact nature. Given the biomechanical interdependence of the lower limb joints, especially within the framework of the kinetic chain, limited hip flexibility may compromise ankle stability. Understanding this relationship is essential for developing effective injury prevention strategies and enhancing athletic performance in basketball players.**[1]**

The concept of the kinetic chain suggests that the body's joints and muscles function in a linked sequence, where movement at one joint affects the others. In basketball, the hip and ankle joints play critical roles in stabilizing and moving the body. If one link in this chain is weak or restricted, it may lead to compensatory movements, increased stress on other joints, and a higher risk of injury. Hip flexibility influences how forces are transmitted through the lower body, potentially affecting ankle stability. Limited hip flexibility can lead to altered movement patterns, such as increased internal rotation or compensation through the knee and ankle joints, which may negatively impact balance and joint stability. **[2]**

Research has shown that restricted hip flexibility is associated with decreased performance in sports involving dynamic movements, such as jumping and sprinting. In basketball, the ability to generate force from the hips through efficient movement patterns is critical for explosiveness, stability, and injury prevention. Inadequate hip mobility can limit the body's ability to perform these tasks, placing additional stress on the ankle joint, which may compromise stability and increase the likelihood of ankle sprains or instability.**[3]**

In the case of the hip flexor muscles, they draw together the upper leg and torso at the hip joint. These muscles get a workout whenever doing movements like climbing stairs, running, or jumping. Tight hip flexor muscles can lead to a limited range of motion, poor posture, and injuries.

II. Review of Literature

The collection of studies examines the connection between hip flexibility and ankle injuries, particularly in dynamic sports like basketball. One systematic review emphasizes the high incidence of ankle sprains in sports and suggests that limitations in hip mobility can lead to compensatory movements that increase the risk of ankle injuries. Several studies investigate how restricted hip

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flexibility especially in movements like flexion, extension, and rotation can cause biomechanical inefficiencies in the lower limbs, contributing to instability and injury in the ankle and knee joints.

Research also explores how limited hip mobility affects lower limb alignment during activities like jumping and pivoting, potentially increasing injury risk. A study highlights how poor balance and proprioception, influenced by hip flexibility, reduce ankle stability and elevate the likelihood of injury. Another article presents a model showing how restricted hip mobility, especially in the posterior chain, contributes to chronic ankle instability.

Some studies confirms that hip- strengthening exercises improve muscle strength, balance, and functional outcomes in individuals with chronic ankle instability. Additionally, techniques targeting both hip flexibility and ankle dorsiflexion are shown to improve dynamic stability and performance post-injury. A biomechanical analysis on athletes with tight hip flexors reveals altered muscle activation patterns, though without significant changes in joint moments or strength.

Overall, these findings support the importance of incorporating hip flexibility and strengthening exercises into athletic training and rehabilitation programs to enhance performance and prevent lower extremity injuries.

III. Methodology

A total number of 50 students were included in the present study according to inclusion and exclusion criteria. All the subjects were taken from Career Point University and Kota Stadium, Kota Rajasthan.

A prevalence study.

Inclusion criteria:

- Active basketball players with a minimum of 1 year of playing experience.
- Aged between 18-25 years.
- No history of recent hip or ankle surgeries (within the past 6 months).
- Players with normal, overweight or obese body mass index (BMI).

Exclusion criteria:

- Players with chronic lower limb injuries (hip, knee, or ankle).
- Players currently undergoing rehabilitation for lower limb injuries.
- Any players with congenital deformities affecting lower limb movement.

Male and female participants will be recruited for this study. Before the collection of data, subjects will be explained about the purpose of the study. The investigator will be given a detailed orientation about the equipment's and various test procedures. Such as Thomas test and CAIT questionnaire to measure the balance and strength to identify the Influence of Restricted Hip Flexibility impact on Ankle stability Function and Strength to Balance Performance in basketball player.

For hip mobility, Thomas test is performed on subjects. The subject lies supine on an examination table and actively flexes the hip on one side, bringing the knee towards the chest. The examiner observes the opposite leg, which should remain flat on the table. A positive test (indicating hip flexor tightness) occurs when the opposite leg lifts off the table. It suggests tightness of the hip flexors, particularly the iliopsoas or rectus femoris. Negative Test If the opposite leg remains flat on the table, it suggests normal hip flexor length.

Followed by CAIT questionnaire, the subjects will be given a Google form via online platform that consist of CAIT questionnaire. CAIT consist of 9-questions which has scores ranging from 0 to 30, with higher scores indicating higher stability, that measures the severity of functional ankle instability. The data of each participant will be collected in Excel work sheet

The table shows the participation of gender in study. No. of total participants is 50, 26 of them are male and 24 of them are female. Mean of each gender which is mean of boys is 0.52 and mean of girls is 0.48.

GENDER	Male	Female
TOTAL	26	24
MEAN	0.52	0.48

Table 6.1: Gender distribution in study

The table shows the leg affected in Thomas test of participants. 28 participants have positive Thomas test in right leg, rest of 22 have positive Thomas test in left leg. Mean of right leg is 0.56 and mean of left leg is 0.44.

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CONTENTS	THOMAS	
Leg	Right leg	Left leg
Total	28	22
Mean	0.56	0.44

Table 6.2: Table of Thomas test

The table shows the ankle affected in CAIT questionnaire. 24 participants have right ankle instability, and 26 participants have left ankle instability. Total score of right ankles is 485 and total score of left ankles is greater than right ankle which is 554. Mean of right ankle is 9.7 and mean of left ankle is 11.08.

CONTENT	CAIT	
Ankle	Right ankle	Left ankle
Score	485	554
Total	24	26
Mean	9.7	11.08

Table 6.3: Table of CAIT questionnaire

The table shows the age distribution among participants from 18-25. Highest number of participants are from age 21 which is 19 and lest number of participants are from age 25 which is 1. In study, there is no participant from age 24.

AGE	NO.
18	3
19	4
20	13
21	19
22	6
23	4
24	0
25	1

Table 6.4: Age distribution of participants

The table shows the number of participants indicating toward positive study (p. study) which is 29 means there is relation between ankle and hip which causes limited hip mobility affects ankle stability. Number of participants is 21 which indicates the study is negative and support that there is no influence of limited hip mobility in ankle stability. 29 participants have ankle stability in same leg as tight hip flexors and 21 have ankle instability in opposite to the tight hip flexor hip.

Study	P. study	N. study
No.	29	21

Table 6.5: No. of participants shows the positive study and negative study.

IV. RESULT

The study was conducted on 50 basketball players to investigate the relationship between hip flexibility and ankle stability, utilizing the Thomas Test and the Cumberland Ankle Instability Tool (CAIT) questionnaire. The Thomas Test was employed to assess hip flexor tightness, with results indicating that a significant portion of participants exhibited reduced hip flexibility. Subsequently, ankle stability was evaluated using the CAIT, a validated tool for identifying functional ankle instability. Findings revealed that 29 out of 50 participants demonstrated ankle instability on the same side as the tight hip, suggesting a notable correlation. Furthermore, 46 participants were classified as having severe ankle instability, while only 4 were categorized within the mild range. These outcomes support the alternative hypothesis, indicating that decreased hip flexibility may contribute to compromised ankle stability and potentially impair performance in basketball players.

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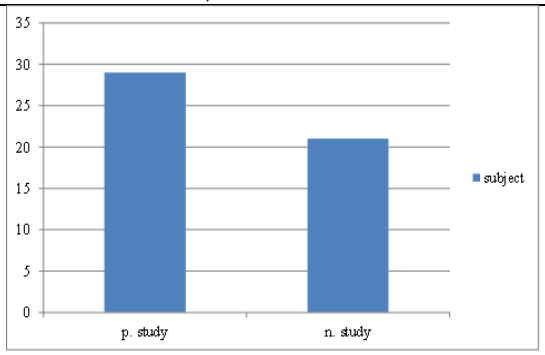


Fig 6.5: Graph showing the number of participants indicates alternative hypothesis (positive study) and null hypothesis (negative study).

Graph shows the majority of 29 participants have the ankle instability in same leg which is affected with tight hip flexor. This indicates alternative hypothesis. As shown in graph, rest of 21 participants do not have relation between tight hip flexors affecting stability of ankle of same leg which indicates null hypothesis. According to our study, 58% of basketball players have ankle instability in same leg as tight hip flexors.

V. Discussion

Lindsay Carroll presented a study in 2018 on Chronic Ankle Instability and Hip Muscle Function: a systematic review. Purpose of this study was to evidence supporting a connection between the hip and ankle in people with chronic ankle instability (CAI) causes clinicians to question how the hip and the ankle may interact in population. Lateral ankle sprains are the most common injury among athletes7 and effect between 2 and 7 people per 1000 in the general population. Up to 60% of these individuals develop chronic ankle instability but the etiology and best practices for management of chronic ankle instability remain unclear. Current conservative treatment for chronic ankle instability includes ankle eversion strengthening, bracing/strapping, lateral wedging, functional training and proprioceptive training.

In article "Improve balance and athletic performance by strengthening weak hips and ankles" written by Brent Pritt, hip and ankle Strength Are Interconnected**,** weak hips can lead to ankle instability, and ankle sprains can worsen hip weakness, creating a cycle of injury risk. Strengthening both areas is essential for balance, stability, and injury prevention. The muscles surrounding your hips, particularly the hip abductors (like the gluteus medius and minimus), are critical for keeping your pelvis level and stabilizing your legs during movement.

These results suggest that rehabilitation programs for CAI should not only focus on ankle-specific exercises but also incorporate hip strengthening. Enhancing hip abductor and external rotator strength may improve dynamic balance and reduce the risk of recurrent ankle injuries. Physical therapists are encouraged to adopt a comprehensive approach that addresses both distal (ankle) and proximal (hip) muscle deficiencies.

VI. Conclusion

In our study, we observed that 58% of basketball players aged between 18 and 25 with limited hip flexibility also exhibited reduced ankle stability on the same side during gameplay. This finding underscores the interconnected nature of the lower limb kinetic chain, where dysfunction in one joint can adversely impact the function and stability of adjacent joints. Specifically, restricted hip mobility appears to compromise ankle stability, which may, in turn, impair overall athletic performance. This relationship highlights the potential for increased injury risk, as well as impairments in balance and postural control, emphasizing the need for comprehensive lower extremity assessments and targeted flexibility and stability training in basketball athletes.

Based on the findings of this study, the null hypothesis—which stated that there is no significant relationship between hip flexibility and ankle stability in basketball players—is rejected. Conversely, the alternative hypothesis is accepted, indicating that reduced hip flexibility has a negative impact on ankle stability and may adversely affect game performance in basketball players. These results reinforce the importance of addressing hip mobility as part of injury prevention and performance enhancement strategies in athletic training programs.

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