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A COMPARATIVE STUDY OF HIP EXTERNAL ROTATOR AND INTERNAL ROTATOR STRENGTHENING ON PAIN AND JUMP PERFORMANCE IN SI JOINT PAIN IN LAWN TENNIS PLAYERS

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ABSTRACT

Background: Tennis is considered a complex and unpredictable sport. Athletes commonly engage in substantial multidirectional movements. tennis strokes are normally unilateral actions and therefore it is the asymmetrical nature of this sport. SIpain is most common in tennis players. It can cause low back pain about 13% of low back pain have origin of pain at SI joint.

Aim: The Aim is to find out the comparison of hip external and internal rotator strengthening on pain and performance in SI joint pain in tennis players.

Method: A total 36 tennis players were selected for the study they were divided into three groups. 12 in each group. Group A was given External rotator strengthening along with conventional exercise, Group B was given Internal rotator strengthening along with conventional exercise, Group C was given only Conventional exercise. The duration of the study was 4 weeks and post pain and jump performance was assessed by NPRS, SLJ.

Result: Kolmogorov Smirnov test was used to check normality of data. Wilcoxon signed Rank test was applied to compare the mean and standard deviations of within-group analysis of all three groups. In within-group analysis p value of group A, B, C was (0.005). Annova test was applied to compare the

mean and standard deviation of between-group analysis of all the groups. Between group comparison, p-value was (0.005).

Conclusion: This study concludes that Group A, who got external rotator strengthening along with conventional exercise for pain and jump performance, showed noticeably superior improvement than in Group B which received internal rotator strengthening with conventional exercise for SI joint pain in lawn tennis players.

Keywords: sacroiliac joint, gluteus maximus, NPRS, SLJ

INTRODUCTION

LBP ranks among the leading causes of disability and places a significant financial burden on the healthcare system each year. Low back pain is more often in middle age and in persons over 50; in high-income nations, its frequency is believed to be between 3 and 20%. Sacroiliac joint dysfunction, accounting for 15–25% of back pain causes, is one of the most prevalent root causes of low back pain **[1]**.

SIJ pain refers to discomfort in the lower back or sacral area, often resulting from issues with the sacroiliac joint's proper functioning. SIJD arises due to changes in the joint's ROM. leading to either excessive movement or restricted movement, which in turn can destabilize the joint. In a notable portion, approximately 15% to 40%, of cases, SIJD contributes to LBP **[2]**. The sacroiliac joints (SIJs) serve as vital connectors between the spine and pelvis, facilitating the distribution of loads from the lower back to the lower extremities **[3]**.

Three distinct joints are formed: one at the front midline known as the pubic symphysis, and the other two at the back called the right and left sacroiliac joints. Positioned at the lower end of the vertebral column, the sacrum is situated between the iliac bones on both sides. This arrangement brings about the merging of these three joints, culminating in the formation of the sacroiliac joint **[4]**. The biceps femoris, GMax, and erector spinae are crucial muscles for maintaining stability in the SIJ. They play a significant role in stabilizing the SIJ. Additionally, the connection of the GMax, along with the support from the thoracolumbar fascia, is vital for providing stability to the sacroiliac joint **[5]** .

When comparing athletes based on the type of movement patterns they commonly perform in their respective sports, we can categorize them into two groups: those who predominantly execute movements that involve one side of their body, and those who primarily engage both sides of their body simultaneously **[6]**.

For athletes involved in sports that emphasize unilateral movement patterns, such as tennis players executing a powerful backhand or baseball pitchers delivering a

pitch, their training and performance heavily rely on the dynamic use of a single side. This specific training can lead to a high degree of asymmetry in muscle development and movement mechanics between the dominant and non-dominant sides of the body. These athletes often require exceptional balance, stability, and coordination to excel in sports that demand precise control over each side's movement **[7]**. A study on the U.S. Senior found that 54.1% of team members suffered from SIJD. Tennis players, due to the intense biomechanical stress on the pelvis, are particularly prone to this condition **[8]**.

Tennis athletes commonly engage in substantial multidirectional movements, including cutting actions and execute uneven pivoting motions brought about by serves and groundstrokes throughout their matches **[9]**.

During the backswing portion of the tennis forehand groundstroke, specific muscles, including the quadriceps, gluteals, gastrocnemius, and hip rotators, undergo eccentric contractions. These contractions start the hip rotation process and prepare the lower legs. These same muscles—the gastrocnemius, soleus, quadriceps, gluteals, and hip rotators—are used in both concentric and eccentric contractions as the swing moves forward. This combined exercise facilitates hip rotation and helps the lower body move **[10]**.

The main role of the GMax muscle is to extend the hip, however, it also serves a vital function in stabilizing both the pelvis and spine. In instances of sacroiliac joint dysfunction, there is disruption in the activation of the gluteus maximus muscle during the pelvis' load transfer process. This results in the suppression of the gluteus maximus and an incapacity to adequately stabilize the pelvis.The proper activation of the GMax muscle is pivotal for maintaining pelvic stability **[11]**. Research has explored the connection between the GMax muscle and the SI joint. Anatomical investigations propose that the gluteus maximus could play a role in because its muscle fibers are oriented parallel to the joint surfaces, supporting the SI joint **[12]**.

Moreover, it has been noted that when the gluteus maximus is activated, it leads to a rise in compressive force applied to the SI joint. it is theorized that a deficiency in gluteus maximus strength might lead to atypical loading of the SI joint, potentially contributing to the impairents linked to SI joint dysfunction **[13]**.

The main role of the Gmed is to manage the movement of the femur, especially during active motions of the lower extremities, while also providing stability to the pelvis in sideways and rotational movements. If the gluteus medius is weak or injured, it can lead to conditions like iliotibial band friction syndrome,

soreness in the lower back and sacroiliac joint **[14]**.

Thus, the goal of the current study is to compare how hip internal and external rotator strengthening exercises affect pain and jump ability in tennis players who suffer from SI joint pain.

MATERIALS AND METHODOLOGY:

A comparative study between hip external rotator and internal rotator strengthening on pain and jump performance in si joint pain in lawn tennis players was seen.36 players with SI joint pain is assessed and exercises was given.pain and physical performance was assessed before and after intervention. Subjects, meeting inclusion criteria after ethical clearance (IEOCHR-SAINATH HOSPITAL/AHMC/86), were informed about the research protocol and provided signed consent.

INCLUSION CRITERIA [2, 15, 16]: Age – 18-25 years**,**Subjects willing to participate**,**Three or more clinical tests for sacroiliac joint are positive(Gaenslen's test, FABER test, approximation test, Distraction test, Ipsilateral posterior rotation test, SLRT)**,**Patient with or without radiating pain and Fortin finger test positive.

Exclusion criteria [17]: Pregnancy, Previous spinal surgery, Malignancy, Spinal abnormalities such as acute disc pain, spondylosis, spondylolysis, and spondylolisthesis, Trauma, Patient with neurological problems such as hypertension, hypotension, and neurological affection due to disc was excluded from the study.

- **OUTCOME MEASURES**: **[7, 18]**

1. Numeric pain rating scale (NPRS): ICC = 0.93
2. Standing long jump (SLJ): ICC = 0.99

➢ **GROUP A: HIP EXTERNAL ROTATOR STRENGTHENING +CONVENTIONAL EXERCISE:**

1. Bilateral bridge **[5]**

The player was lying with their legs and hips bent in a curve. To give stability, the patient's palms should be towards the floor or a plinth. The players feet were placed on a surface, and they were told to elevate their pelvis gradually by pressing their feet together. They were also advised to maintain equal pressure on both hands. Following the raise, give the patient instructions to contract and then relax their gluteal muscle before lowering themselves gently to the plinth or floor. Repeat the exercise for 10 times.

2. Hip abduction in quadruped (fire hydrant) (elastic resistance) **[5]**

For this exercise ask the patient to stay in the quadruped position, keeping back straight. Then with the right knee bent at 90 degree lift the knee out to the right and up getting away from the body. Hold the position and get back in the resting stage. Repeat the exercise for 10-20 times keeping elbow

extended. After that repeat the same on other side.

3. Hip extension in prone with knee flexed (elastic resistance) **[5]**

Lie on the stomach on the pillow with leg straight. Hand should rested on the arms. Raise right leg a few inches off the floor. Keep the right leg straight. Hold for 10 sec. slowly lower your leg. Continue the same manner on the opposite side.

4. Deadlift (with elastic resistance) **[5]**

The participant in a standing position put an elastic band on both leg one knee is bend. Object is placed at anterior to player. Ask player to touch object with one knee bent.

Dosage: All the exercises performed 2 times per week for 4 weeks.10 repetitions,10 sec hold

- **Group B: HIP INTERNAL ROTATOR STRENGTHENING +CONVENTIONAL EXERCISE**

1. Side lie **[7]**

Assume a side-lying position with knees bent at a 90-degree angle, ensuring they remain together throughout the exercise. Elevate your foot upwards as far as without shifting your pelvis. Focus on feeling the contraction in the hip's side muscles. Repeat this movement 10 times. To progress, incorporate a resistance band placed between the feet.

2. Hip shift on wall **[7]**

Lie down on the floor. Position feet against the wall, bending your hips and knees at a 90-degree angle. Press feet firmly into the wall and raise your tailbone off the ground. Bring left knee towards your hip while pushing right knee away from your hip. Ensure that thighs are straight and parallel to each other, and feel the muscles in left inner hip engaging. Hold this position for 10 seconds.

3. Wall press **[19]**

During the wall press exercise, instruct to stand near the wall with their right limb closest to the wall. Then, ask them to take a single leg stance by flexing left hip to a 60-degree angle. The inner side of the right foot should be positioned away from the wall. Tell them to stay in this posture while you simultaneously press their left leg, ankle, and knee up against the wall.

4. Pelvic drop **[19]**

Instruct the player to lightly place one hand on the wall for balance support. The patient should stand on their right lower extremity on a 15 cm step. keep both knees extended, instruct the player to step back onto the step after lowering their left foot towards the ground.

Dosage: All the exercises performed 2 times per week for 4 weeks.10 repetitions,10 sec hold

GROUP C: CONVENTIONAL EXERCISE: [6]

1. Knee to Chest:

Keep both feet flat along with bending your knees on the ground. Pull one knee with

both hands towards the shoulder. Hold the position for 10 sec against the chest. Repeat on other leg.

2. Crunches:

On your back, lie down feet positioned on the ground. Bend your knees and position your arms straight to the floor contract the abs and inhale exhale and lift upper body keep head and neck relax. inhale and return to starting position.

3.Cat and camel:

Get onto hands and knees. Hand is under shoulder, knees are under hips, and back is neutral. Sink back down to the floor. Make a bend using the spine. Then tuck the head and tailbone in, arching the spine like a hump.

Dosage: All the exercises performed for 2 times per week for 4 weeks.10 repetitions,10 sec hold

RESULTS:

The SPSS version 26 was used to examined data. Wilcoxon signed Rank test was applied to compare the mean and standard deviations of within-group analysis. and Annova test was applied to compare the mean and standard deviation of between-group analysis. and between two independent group comparisons, Mann Whitney test was used. The confidence Interval for the study was kept at 95%. The significant level was kept at <0.05.

Table 1 suggest mean age was 21.85,20.67,20.75 respectively.

Table 2 shows that within group analysis of all three groups suggested statistically significant differences in both the outcome measures. Pre-post analysis of data shows p value was less than 0.05.

Table 3 shows that between the group analysis of all three groups. Between-group comparison shows significant effect on NPRS, which suggests P value of less than 0.05.

Whereas, standing long jump shows more than 0.05 value, which suggests a non-significant effect. But mean of SLJ in group A was 204.33 and post was 214.83 and in Group B was 196.42 and post 202.33 so post mean in group A was more so its significant effect.

Table 1: Mean Age of three groups

Parameter	Hip external rotator strengthening	Hip internal rotator strengthening	Conventional exercise
	Mean ±SD	Mean± SD	Mean ± SD
Age	21.58 ± 2.15	20.67 ± 2.23	20.75 ± 2.30

Table 2: Within group analysis of all outcome measures

Outcome measures		Group A		Group B		Group C	
		Mean± SD	P value	Mean± SD	P value	Mean± SD	P value
Nprs	Pre	6.92± 1.68	<0.001	6.67 ± 1.67	<0.001	6.58 ± 1.38	<0.001
	Post	2.75 ± 1.06		3.92 ± 1.51		5.08 ± 1.73	
SLJ	Pre	204.33 ± 25.31	<0.001	196.42 ± 34.19	<0.001	215.83 ± 28.54	<0.001
	Post	214.83 ± 26.39		202.33 ± 33.82		218.83 ± 28.79	

Table 3: Post-Intervention Between Groups Comparison Of The Nprs And Standing Long Jump (ANNOVA)

Outcome measures	Group A	Group B	Group C	P value	F value
Pre NPRS	6.92 ±1.68	6.67± 1.67	6.58 ±1.38	0.854	7.691
Post NPRS	2.75± 1.06	3.92 ±1.51	5.08 ± 1.73	0.003	
Pre SLJ	204.33 ±25.31	196.42 ±34.19	215.83 ± 28.54	0.223	0.999
Post SLJ	214.83 ± 26.39	202.33 ±33.82	218.83± 28.79	0.370	

DISCUSSION:

Numerous pieces of literature propose that activities such as mobilization, MET, and muscle flexibility can alleviate discomfort and disability associated with sacroiliac (SI) joint pain. Various studies have indicated that strengthening the hip rotator muscles may contribute to the enhancement of pain management, overall quality of life, and functional abilities in individuals experiencing SI joint disability.

The study found that all groups, A, B, and C, experienced significant reductions in both pain and standing long jump performance after the intervention ($p<0.05$). Group A focused on conventional exercises combined with hip external rotator strengthening, Group B on hip internal rotator strengthening with conventional therapy, and Group C solely on conventional exercises. Between-group comparison showed a significant effect on pain reduction (NPRS) with a p-value less than 0.05. However, for standing long jump performance, the comparison did not yield a significant effect, with a p-value exceeding 0.05.

For people with pain in their SI joints, doctors often recommend doing exercises to make their muscles stronger. This helps to stabilize the SI joint by keeping it steady while moving. The SI joint has flat surfaces that go up and down, which is good for supporting weight. But this also makes it easy to get injured from up and down forces. The ligaments around the SI joint can stretch out over time if they're under pressure for too long. This means that the muscles and tissues around the lower back and pelvis are really important for keeping the SI joint stable **[13]**.

Marco Aurelio N *et al* showed that the Gmax, can push down on the SI joint and help move weight between the legs and body. Even though experts aren't sure if SI joint pain comes from an unstable joint, recent studies suggest that doing exercises to strengthen the GMax assist those who have SI joint problems feel less pain and move better. In a recent study, people who did these strengthening exercises had less pain and could do more activities.so, it is better to do external rotator strengthening exercise for player with SI joint pain in tennis players **[13]**.

Previous studies have been proposed that a delay in the activation of the GMax muscle could alter the pressure exerted on the sacroiliac (SI) joint and impact the body's ability to effectively distribute weight. This delay in gluteus maximus activation has been seen in people with SI joint pain. So, it seems logical that exercises should focus on improving the timing and function of the gluteus maximus muscle. Although we're not sure if the muscle activation patterns of the gluteus maximus returned to normal, the people in the study did get stronger and could move better after doing the exercises **[13]**.

Kieran O'Sullivan and his team undertook a study investigating the electromyographic (EMG) activity of the three segments of the GMed during weight-bearing exercises. They noted that among these exercises, the wall press (WP) elicited the most significant EMG amplitudes across all three segments. Despite its widespread use the efficiency of the WP exercise in stimulating the gluteus medius in clinical situations has not been assessed before. These findings suggest that the WP exercise is a valuable isometric strengthening method for the gluteus medius, particularly targeting its posterior segment. However, in this study did not demonstrate significant improvement in the group focusing on internal rotator strengthening exercises **[20]**.

The study highlights the complex and dynamic nature of tennis, emphasizing the multitude of factors that influence gameplay. It underscores the importance of designing training programs that address various physiological, technical, and tactical aspects of the sport to optimize performance. By incorporating court-specific conditions and refining techniques, significant improvements in overall performance can be achieved. The study's findings, which show a notable increase in standing long jump performance after a training program focusing on hip external rotator strengthening, align with previous research and suggest the effectiveness of this approach in enhancing physical performance in tennis players **[21]**.

Many researches are there on hip rotator strengthening can reduce SI joint pain,but which rotator strengthening was better is not yet done.so, this study was concluded that hip external rotator strengthening can reduce pain in SI joint and improve physical performance lawn tennis players.

CONCLUSION

This study found that Group A, who got external rotator strengthening along with conventional exercise for pain and jump performance, showed noticeably superior improvement than in Group B which received internal rotator strengthening with conventional exercise as a result, both

exercises reduce pain and improve physical performance in lawn tennis players.

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