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EFFECT OF PERCUSSIVE MASSAGE THERAPY AND FOAM ROLLING VERSUS FOAM ROLLING ALONE ON FLEXIBILITY AND JUMP PERFORMANCE IN TRACK ATHLETES

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Abstract: **Background: Flexibility and jump performance are essential motor skills for athletic performance. Flexibility supports proper biomechanical function, while vertical jump ability reflects lower-body power. Warm-up routines often include techniques like foam rolling and percussive massage therapy, which have been shown to enhance flexibility and performance.**

Objective: To compare the effects of percussive massage therapy combined with foam rolling versus foam rolling alone on hamstring flexibility and vertical jump performance in track athletes.

Methodology: A pre-post experimental study was conducted with 30 track athletes, divided into two groups (n=15 each). Group A received percussive massage therapy and foam rolling. Group B received foam rolling alone. The intervention lasted six weeks. Hamstring flexibility was assessed using the Modified Sit and Reach Test, and jump performance was measured using the Vertical Jump Test.

Results: Post-intervention analysis using unpaired t-tests showed Significant improvement in flexibility for Group A compared to Group B (t = 8.927, p < 0.05). Significant improvement in vertical jump performance in Group A compared to Group B (t = 3.612, p < 0.05)

Conclusion: Percussive massage therapy combined with foam rolling significantly improves hamstring flexibility and jump performance more than foam rolling alone in track athletes.

Keywords: **Track athletes, Percussive massage therapy, Foam rolling, Flexibility, Jump performance.**

I. INTRODUCTION

Athletics, encompassing both track and field events, is a Global Olympic Sport that is widely practiced across various Countries. It is governed at the International level by the World Athletics, which has a total of 214 affiliated countries or territories Worldwide. Athletics has several different disciplines, including sprints, hurdles, jumps, throws, combined events, middle and long distance running and race walking. [1] The word Athletics is an Ancient Greek word, Athlos meaning 'contest' or 'task' and Athlon meaning 'prize'. [2] Sports injury and fear of injury are important barriers to participation in sports, despite the health benefits of sports activities. [3] Athletes in track and field face a significant challenge due to hamstring muscle injuries (HMI). According to 2020, HMI is one of the most prevalent injuries, especially in disciplines requiring high running velocities, with about 20% of athletes sustaining an HMI per season. HMIs account for 17% of all

injuries during international athletes' championships, ranging from 0 to 35% according to sex and athletic discipline. [4] Hamstring injuries frequently occur among track and field athletes, with a greater prevalence in Males compared to Females. The Hamstring reinjury rate is high. The mechanism of hamstring injury is inconclusive. Some studies suggest that hamstring injury primarily occurs during the early stance phase, while others indicate the swing phase. A forward lean during sprinting also identified as a risk factor for hamstring injury. [5] Athletes experience muscle fatigue, which can lead to significant adverse effects on their bodies and may result in injuries (muscle wear). This fatigue can temporarily hinder their ability to participate in sports activities. A 2 substantial majority of these injuries, approximately (86.5%), occur in the lower limbs. One significant aspect of hamstring efficacy is Flexibility. [6] By definition, Flexibility is the ability of a muscle to lengthen and allow one or more joints to move through a range of motion (ROM), wherein loss of flexibility decreases the ability of a muscle to perform optimally. [7] Hamstring strength, Flexibility and Endurance are the foundational components of athletic performance, playing pivotal roles in power generation, injury prevention and overall functional capacity. Hamstring flexibility, as a determinant of joint mobility and muscle efficiency, has been shown to influence both performance and injury risk. Limited flexibility can disrupt movement patterns, particularly in sports requiring high speed running or jumping. Conversely, excessive flexibility without adequate strength can compromise muscle stiffness, impairing explosive performance. [8] Another current method that is alternative stretching exercise in gaining flexibility is percussive massage therapy. It has gained popularity in the therapeutic and athletics. Such devices (e.g. Thera gun and hyper ice) can vibrate at different frequencies up to 53Hz. The response may vary based on the type of tissue involved, such as soft tissue in contrast to bony tissue, several attachment heads can be fixed to the device so that local points can be massaged. The Golgi tendon organ is activated through rhythmic contraction and relaxation, which helps in reducing abnormal muscle contractions and enhances muscle length. Massage applied for 5 minutes with a hand-held percussion device provides an increased in ROM with the effect of myofascial relaxation. [9] 3 It is used to promote blood flow, reduce myofascial restriction and tension, improve range of motion, alleviate pain and break up trigger points. It is used in both clinical and sporting contexts, for pre-activity (warm up), post -activity(recovery) or a part of treatment. [10] . Foam rolling (FR) is a form of self-massage in which targeted musculature is rolled and compressed. With FR, athletes use their bodyweight to apply pressure to the soft tissues during the rolling motion. The motions place both direct and sweeping pressure on the soft tissue, stretching it and generating friction between it and the FR device. [11] FR permits certain improvements in physical active, healthy adults with regard to flexibility, delayed onset muscle soreness (DOMS) and range of motion. [12] Jumping performance, a hallmark explosive strength, relies heavily on hamstring strength and torque. Imbalance in hamstring strength often leading to reduced jump height and increased injury risk during dynamic actions. [8] Vertical jump performance which may be achieved by a higher contraction velocity and/or muscle force of the extensor muscles of the trunk, hip and lower extremities. VJP can be improved by plyometric training (PT), weight bearing (WB), vibration training (VT) and electromyostimulation training (ET). [13] Vertical jump is measured by calculating the vertical displacement of centre of mass or the fingertips during the interval between the moment the individual stands on the ground and the point at which the individual reaches the maximum jump height. The anthropometric parameters (height, weight, body circumference, limb length) can also affects the vertical jump of an athlete. [14] 4 The movement that are widely used to monitor athletic performance are the countermovement jump (CMJ) and squat jump (SJ). In the CMJ, the athlete starts from a standing position and initiates a downward movement, which is immediately followed by an upward movement leading to take-off. In contrast, during the SJ, the athlete descends in semi-squat position and holds approximately 3 sec before take-off. [15] The stretch-shortening cycle is used in which muscles undergo an initial tension when the knee and hip are flexed; then, in the second phase of the jump, the explosive force is produced by the muscles, and the rapid extension of knee and hip joints leads to apply force to the ground for take-off. [10].

II. METHODOLOGY

STUDY DESIGN:

The study design was a pre-test and post-test experimental study design.

STUDY SETTING:

The study was conducted at KG Physiotherapy and Rehabilitation centre, K.G College of Physiotherapy, Saravanampatti, Coimbatore. The study was done under the supervision of my guide.

STUDY DURATION:

The study was conducted over a period of 6 months, The treatment duration was total of 4 days per week, 1 session, per day for 6 weeks.

STUDY POPULATION:

The study population was tracks athletes.

STUDY SAMPLING:

30 track athletes were selected based on the inclusion and exclusion criteria. By random sampling method subjects were divided into 2 groups, each group with 15 members.

CRITERIA FOR SELECTION:

Inclusion Criteria was Age - 18 to 25 years, Gender - both male and females are included, Athletes who has involved in track events for at least 2 years, BMI of 18.5-24.9 was included, Good health status – free from any musculoskeletal injuries or conditions that may affect flexibility or jump performance, those who were willing to participate were all considered for admittance. Exclusion Criteria was History of hamstring injuries, such as sprain (lasting less than 3 months), Recent fracture of the lower extremity, Individuals with recent musculoskeletal disorders like back, neck, hip, knee and ankle pain, Individuals with chronic pain conditions, Individuals currently experiencing any cardiovascular, respiratory and neurological disorders, Current episodes of low back ache, History of fall or balance problems, History of paraesthesia.

PROCEDURE:

For all the 30 subjects the Pre-test evaluation was done. The Modified Sit and Reach Test were used to evaluate the hamstring flexibility and the Vertical Jump Test was used to evaluate the jump performance (Vertical jump height). Totally 30 subjects were participated in this study and they were randomly divided into two groups. Each group consists of 15 members. Before the training program, all two outcome measures and demographic data are documented.

Group A underwent both Percussive massage therapy and Foam rolling. Both hamstrings received the Percussive massage therapy for a total of 10 minutes (5 mins on right hamstring and 5 mins on the left) with frequency of 53Hz using the “Hardball”. Foam roller was applied to the participants in sitting position. The participants rolled one hamstring for 5 mins and same thing with the other. Engage in a reciprocal motion of rolling back and forth for a duration of 1 min, then transitioning to the other side. Duration- Six weeks on the basis of four days per week and group B is advised to do proper stretching before training and only Foam rolling were applied. Duration- Six weeks on the basis of four days per week.

FOAM ROLLING:

Foam rolling is a form of self-myofascial release commonly used by athletes, fitness enthusiasts, and physiotherapists to improve flexibility and reduce muscle soreness. It involves placing a foam roller between the body and the ground, then moving back and forth over it to target muscles like the hamstrings. Foam rolling helps treat myofascial pain and can be used in both rehabilitation and prevention. It's commonly incorporated in warm-up routines before workouts and as part of post-workout recovery. It enhances muscle flexibility, reduces tightness, and speeds up recovery. The technique is beneficial for both endurance and strength athletes. Foam rolling promotes quicker muscle recovery and prevents injury. The foam roller with pattern and grooves is used in this study. The pattern on the surface of the roller allows it to place different amounts of pressure on the muscle, which has been theorized to promote the circulation. The greater pressure to be placed on areas of adhesion and tightness. The foam roller with pattern and grooves is used in this study. The pattern on the surface of the roller allows it to place different amounts of pressure on the muscle, which has been theorized to promote the circulation. The greater pressure to be placed on areas of adhesion and tightness. For hamstrings, starting just inferior to the gluteal fold with the hip unsupported, participants crossed 1 foot over the other. Their body mass was supported and maneuverer by the hands, which were posterior to the body. They rolled from the starting position down to the superior portion of the popliteal fossa and back Total foam rolling time, including rest, was 20 minutes (15 minutes of rolling and 5 minutes of rest).

PERCUSSIVE MASSAGE THERAPY:

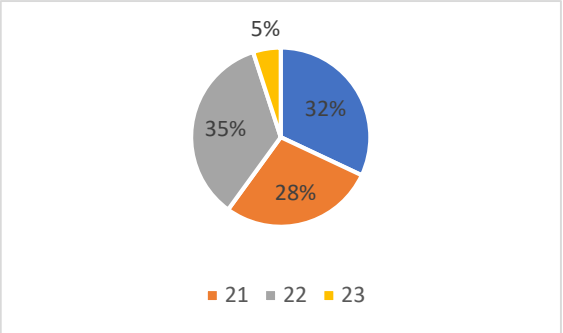
Percussive therapy (also called “Deep muscle stimulation’) the introduction of the percussion vibrator which was applied to the local areas of the body for deep tissue osteopathic treatment for musculoskeletal pain. It is a breakthrough treatment for soft tissue pain and soreness through the use of a tool that provides rapid pulses in short duration of pressure to the muscle belly or tendon. The effect of percussive therapy delivered by massage gun. The massage gun head impacts the fascia, which can cause myofascial release.it Improves acute muscle strength, it can improve short term Flexibility of

hamstrings, reduce experiences of musculoskeletal pain and spasms, Relieve tension in the muscle. Percussive massage was applied to the dominant hamstring for 5 minutes using a Hypervolt device at 53 Hz with the "hard ball" head. The first 2.5 minutes focused on the semimembranosus and semitendinosus muscles, starting medially and moving distally to proximally, then back distally. The next 2.5 minutes targeted the biceps femoris, moving laterally at the distal end. Each muscle was massaged from medial to lateral. After treatment, participants rested for 30 minutes before final measurements were taken. Percussive massage is applied for hamstring muscle for 5 minutes at 53Hz frequency.

III. DATA ANALYSIS AND INTERPRETATION

Age group classification:

AGE	PARTICIPANTS	PERCENTAGE
20	8	32%
21	7	28%
22	9	35%
23	6	5%



Gender classification:

S.NO	GENDER	MEMBERS	PERCENTAGE
1.	male	16	57%
2.	female	14	43%
TOTAL		**30**	**100%**

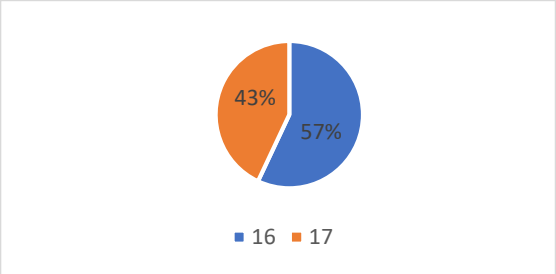
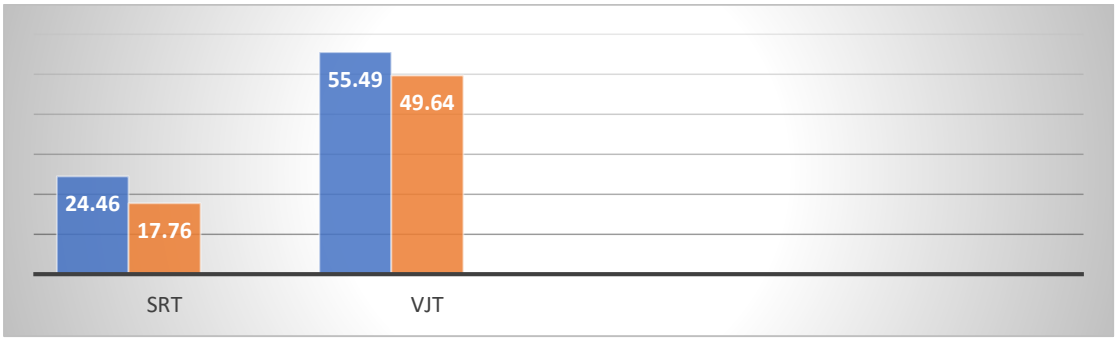


TABLE III SHOWS DISCRIPTIVE ANALYSIS OF MODIFIED SIT AND REACH TEST AND VERTICAL JUMP TEST:

PARAMETER	TEST	MEAN ± SD	TABLE T VALUE	P VALUE
SRT GROUP A	**POST TEST**	**24.46 ± 1.00885**	**5.71956**	**0.05**
SRT GROUP B	**POST TEST**	**17.76 ± 0.59535**		
VJT GROUP A	**POST TEST**	**55.49 ± 0.79375**	**5.62241**	**0.05**
VJT GROUP B	**POST TEST**	**49.64 ± 0.6718**		

TABLE III shows the analysis of modified sit and reach test between Group A and Group B. Using unpaired 't' test with 14 degree of freedom and 0.05% as a level of significance, the calculated 't' value is 5.71956, which was greater than the tabulated 't' value or critical value is 2.145. the result shows that there was marked difference between group A and group B values. Group A shows clinical significance than the group B. For Vertical Jump Test between Group A and Group B. Using unpaired 't' test with 14 degree of freedom and 0.05 as a level of significance, the calculated 't' value is 5.62241, which was greater than the tabulated 't' value or critical value is 2.145. the result shows that there was marked difference between group A and group B values. Group A shows clinical significance than the group B.



IV. DISSCUSSION

The objective of this study was to find out the effect of percussive massage therapy and foam rolling versus foam rolling alone in flexibility and vertical jump performance in track athletes who were brought to examine if the inclusion of percussive massage therapy and foam rolling in a warm-up routine had any immediate impact on flexibility and jumping performance. The finding of this study revealed that the group that received percussive massage therapy and foam rolling technique improved significantly when compared with the group that received myofascial form rolling technique alone based on results obtained from Sit and Reach Test and Vertical Jump Test. There was a significant improvement in hamstring flexibility and jump performance in track athletes after 6 weeks of interventions. Anatomic and functional aspects of the hamstrings, including the fact that muscles cross two joints (biarticular muscle passing through hip and knee) except the short head of the biceps femoris and that eccentric action during running or stretching carried out to extreme joint positions, make it prone to vulnerable to strain related injuries. The hamstrings are important for sport activities which include forward and backward motions, During the backward motion, the hamstrings act using concentric action in hip extension and knee flexion and lateral rotation. During the forward motions, hamstrings act eccentrically to decelerate hip and knee during respective hip flexion and knee extension motions. The decelerating action of hamstrings occur at a position where these muscles are passively insufficient. For these reasons, the hamstrings are prone to injury during high velocity running, due to eccentric loading at the end of swing phase. THE ROLE OF FLEXIBILITY The authors showed there was moderate yet conflicting evidence associating hamstring flexibility and musculoskeletal injury risk. As previous hamstring injuries reduce flexibility until 20-30 days post injury, but reduced does not necessarily increases injury risk. [33] The mechanical mechanisms of form rolling such as reduction in tissue adhesion, altered tissue stiffness and thixotropic responses. Within neurological model, FR may potentiate analgesic effects and muscular recovery by mediating pain modulatory systems. Physiological mechanisms include enhanced blood circulation, activation of parasympathetic pathways, inflammatory responses, and the breakdown of associated trigger points. psychophysiological responses may include improved perception and recovery due to increase of plasma endorphins, decrease arousal level. Effect of FR on flexibility would be attributed to the altered viscoelastic and thixotropic properties of the fascia (i.e. remobilizing the fascia back to gel like state) as well as increases in intramuscular temperature and blood flow due to friction created by the foam roller and the mechanical breakdown of scar tissue. In colloidal substance the thixotropic effect only lasts as long as the pressure or heat is applied and within minutes it returns to its original gel state. In addition to this, FR may enhance flexibility through a mechanism known as autogenic inhibition. As the FR device applies pressure to the muscle tissue, it is believed that mechanoreceptors called Golgi tendon organs sends a message to the central nervous system to relax that muscle from tearing. However, it is found that GTOs were insensitive to the tension through stretching. Short term improvements in flexibility is due to the effect of FR on the central pain modulatory system. Constant and vigorous pressure exerted on 48 the soft tissue may overload the skin receptors, thus inhibiting or minimizing pain sensation and increasing stretch tolerance. [11] Sensory Stimulation and Mechanoreceptor Activation FR stimulates sensory receptors embedded within the muscles and surrounding fascia. Mechanoreceptors (GTOs and muscle spindles) detects the mechanical stimuli. Relaxation Response and Neuromuscular Adaptation FR triggers responses within the target muscles (i.e. the GTOs between the muscles and tendons). The pressure from the foam roller temporarily suppresses muscle spindles, removing muscle tightness. As the result, this neuromuscular adaptation allows for increased muscle flexibility and improved ROM. Increased Blood Flow and Tissue Oxygenation When treated with foam roller, the mechanical stress causes the specialized cells in the blood vessels wall to release nitric oxide synthase (NOS). NOS interacts with the amino acid I-arginine to foam nitric oxide. Nitric oxide is a potent muscle relaxant. It causes the blood vessel wall to relax and widen, increasing blood flow. Nitric oxide improves oxygen utilization, delays the onset of fatigue and enhances endurance performance. [34] Percussive massage can change the fluid viscosity causing pressure and friction on the applied muscles, skin and fascia, thus leading to less resistance

to movement. Increase in ROM can be due to reduction in muscle stiffness as well as change in pain perception. Pacinian sensory receptors (mechanoreceptors) have a greater influence on movement control muscle activity, resulting from their response to local vibrations. It increases the blood flow, the flow of interstitial fluid into the blood stream via dilated blood vessels and thixotropic tissue alterations, which has a neurological inhibitory effect on the central nervous system [15]. It is hypothesised that the frequency at which the percussive therapy devices compressed the muscles could over-stimulate non-nociceptive impulses to the muscles blocking the nociceptive impulses. The proposed mechanism suggests that the inhibition of nociceptive impulses may lead to a relaxation effect that diminishes muscle guarding. However, individuals undergoing PT with highly sensitive nociceptive fibres might experience an increase in soreness and muscle guarding as a result of the treatment. Additionally, percussive and vibratory devices have been reported to strongly influences afferent discharge within muscle spindles and fast adapting mechanoreceptor, with resultant improvements in pain threshold. Therefore, improvements in pain tolerance to stretch may explain the attained increases in ROM. [28] Clinical implication: The implication of the study is that percussive massage therapy and foam rolling can be used to improve the hamstring flexibility and jump performance in track athletes.

V. CONCLUSION

The purpose of this study is to find out the effect of percussive massage therapy and foam rolling versus foam rolling alone on hamstring flexibility and jump performance in track athletes. Thirty subjects were selected and divided into two groups using simple random sampling. Group A subjects underwent percussive massage therapy and foam rolling whereas group B underwent foam rolling for 6 weeks. Hamstring flexibility and jump performance were measured before and after the training sessions. Hamstring flexibility was measured using Modified Sit and Reach test. Jump performance was measured using Vertical Jump Test. Both pre and post-test measures were obtained, by the use of these values, within the group and between the group analysis were done. Based on the findings the results were obtained. According to the data analysis and interpretation, the null hypothesis (Ho) rejected and the alternate hypothesis(H1) is accepted which states ‘there is a significant difference between the effect of percussive massage therapy and foam rolling versus foam rolling alone on flexibility and jump performance in track athletes.

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