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Immediate effect of percussion massage gun on hamstring flexibility in young adult recreational Footballers: A pre-post experimental study

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Abstract
Background: The hamstring muscles is one of the least flexible lower limb muscle among footballers, which in recreational footballers is commonly associated with injuries. While percussion massage guns, popularized by athletes for recovery and restoration, however, there is lack of data regarding the acute effects on hamstring flexibility.
Objective: This study aimed to evaluate the immediate effect of a 5 minute percussion massage gun protocol on the flexibility of the hamstrings.
Methods: This single group pre-post experimental study enrolled 80 young adult recreational footballers (mean age range: 18-25 years). Participants received a 5-minute percussion massage gun treatment applied to bilateral hamstrings (2.5 minutes each hamstring). The YMCA Sit and Reach Test was used pre and post intervention, which is an established measure of posterior chain extensibility.
Results: 80 participants completed the study. Statistical analysis was performed using paired t –test. YMCA sit and reach test values post intervention increased from 14.23±3.31 to 15.66±3.34 (p value <0.001) which is statistically significant.
Conclusion: The brief 5-minute single application of the percussion massage gun protocol leads to an immediate and significant increase in hamstring flexibility among young adult recreational footballers. These findings suggest that percussion massage guns could serve as an effective warm-up intervention for enhancing hamstring compliance and could possible reduce injury risk in this population.

Keywords: Percussion massage gun, Hamstring flexibility, Sit and Reach Test, Recreational football players, Warm-up, Hamstring Injuries

Introduction

The Hamstring Muscle Complex lies in the posterior region of the thigh consisting of the biceps femoris which is situated laterally and the semitendinosus and semimembranosus which is present medially. [1]

The biceps femoris has 2 heads, long and short of which the long head originates from the ischial tuberosity of the hip and joins the short head to form a common tendon which inserts to the head of the fibula. Extension, adduction and slight inversion of the thigh at the hip joint is done by this muscle. The semitendinosus originates from the ischial tuberosity and it is cord like muscle, inserting at the medial surface of the proximal tibia as a part of pes anserinus. This muscle extends, adducts the the lower limb at the hip joint, also internally rotation of the lower leg at the knee joint. The semimembranosus is broad and flat lying deeper to the semitendinosus and is a strong extensor and adductor of the thigh at the hip joint. [2]

Football is one of the most popular recreational sports in the world, with rising interest among youngsters in India. This sport requires physical endurance, repetitive kicking movement, rapid change in direction, immediate deceleration which places considerable biomechanical load on the joints of the lower limbs mainly knee and ankle joints.[3] The sport is associated with high incidence of musculoskeletal injury. Repetitive acceleration and deceleration in combination with high training volume and intensity places stress on the thigh muscles and knee ligaments. Hamstring strain injuries are the most prevalent muscular injuries, representing 34% of all muscle injuries in footballers. [4] Reduced hamstring flexibility is common among footballers and is linked with impaired sprinting, kicking performance, and an elevated risk of strain injuries. Specifically in recreational football players, irregular training, inadequate warm-up routines lead to high incidence of hamstring tightness. [5]

Handheld percussion massage guns are gaining popularity in rehabilitation settings as a method to improve soft tissue function and for recovery post workout. [6] Mechanisms for these effects include reduced tissue stiffness, changes in viscoelastic properties supported by neuromuscular and vascular responses like accelerating metabolic waste clearance and promoting interstitial fluid flow along with activating mechano-receptors through pressure stimulation causing inhibition of pain signal transmission.[7] These vascular response is local as cardiac output and heart rate remain unchanged.[9] Stress from the vibration leads to change in level of nitric oxide, prostaglandins and acetylcholine concentrations which in turn leads to increase in the flow of blood . [10]

Most available studies used small samples, non-footballing populations, and have assessed hamstring flexibility with goniometric tests than simple field measures. [8] The YMCA Sit and reach test show moderate criterion-related validity for estimating hamstring extensibility, especially when angular testing is less feasible in larger applied studies.[11] This leaves a practical gap regarding the immediate effect of percussion massage guns on hamstring flexibility in recreational footballers, a group that is physically active, frequently exposed to hamstring strain, and relevant to field-based physiotherapy screening

Materials and Methods

Study Design and Setting

This was a single group pre-post experimental study conducted over 6 months in Pune, Maharashtra, India. This study received ethical clearance from Institutional Ethics Committee of PES Modern College of Physiotherapy, Shivajinagar, Pune-05. Written informed consent was obtained from all participants before enrollment to the study.

Selection Criteria

Eighty recreational footballers were recruited via purposive sampling. Eligibility criteria is as follows.

Inclusion Criteria:

- Males
- Young Adults(18-25)
- Recreational Footballers with <2hrs/week gametime.

Exclusion Criteria:

- Musculoskeletal injury of lower limb in the previous 12 months
- Fractures or injuries to the spine
- Recent surgeries of spine or lower limb.
- Pain or Swelling at the knee joint.

Outcome Measure

YMCA Sit and Reach Test: The YMCA Sit-and-Reach Test is a common field test used to assess hamstring and lower back flexibility. A yardstick is placed on the floor along with a tape measure placed perpendicular to it at the 15-inch mark. Participant sits with legs completely extended and heels at the edge of the tape 12-inches apart. The participant then bends forward and the farthest distance reached with the hands is recorded. This test is repeated 3 times and the farthest distance is noted down. Hamstring extensibility will be measured using YMCA Sit-and-Reach test pre and post intervention. High test-retest reliability of 0.8-0.95. [11]

Intervention: Percussion Massage Gun Protocol

Protocol begins with subject in prone position, percussion massage gun will be used in a proximal to distal pattern on the posterior aspect of the thigh, at 1200rpm (speed setting 1). The percussion massage gun will be used alternating for 1 min on each leg followed by alternating the legs for 1 min 30 seconds for a total of 5 minutes.

Statistical Analysis

The data was entered, tabulated and subjected to statistical analysis in Microsoft Excel using paired t-test to compare the change of YMCA Sit-and-Reach test values pre-post protocol intervention.

Results

The mean pre-intervention YMCA sit and reach test value was 14.225 ± 3.31 inches, increasing to 15.65625 ± 3.34 inches post-intervention. This change shows p value <0.001 (two-tailed $p = 4.21 \times 10^{-33}$) which is statistically significant and thus using percussion massage has an immediate effect in increasing the flexibility of hamstrings (Table 1).

Table 1: Pre- and post-intervention outcome measure values (Mean ± SD)

Outcome Measure (YMCA Sit and Reach test)	Mean (in inches)	p-value
Pre Intervention	14.225 ± 3.31	<0.001
Post	15.65625 ± 3.34	

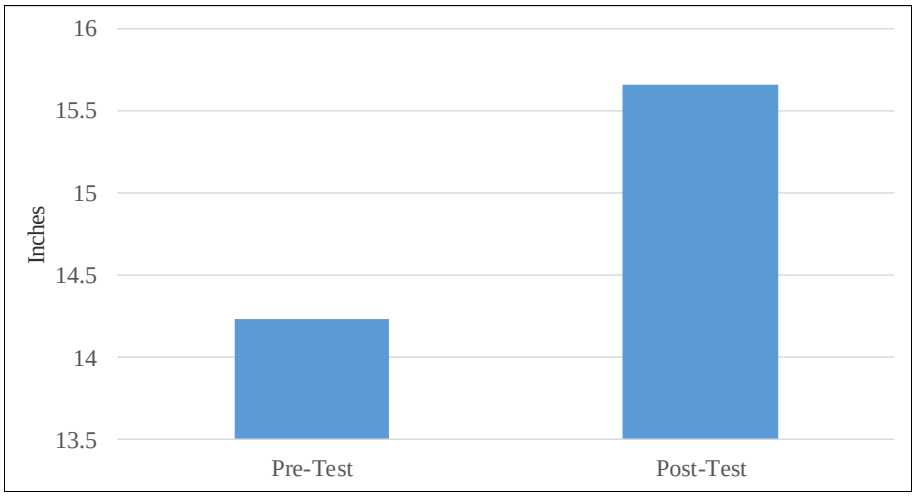

Fig 1: Mean Hamstring Flexibility Pre vs Post Intervention

Discussion

This study evaluated the immediate effectiveness of percussion massage gun on hamstring flexibility of hamstring in young adult recreational footballers. In this study 80 males of the age group 18-25 were assessed pre and post a 5 minute percussion massage gun intervention using the YMCA Sit-and-Reach Test. The outcome measure showed significant improvement post-intervention, with mean length increasing by approximately 10% (14.225in to 15.65625in). These findings are consistent and contribute to the existing evidence supporting the percussion massage gun as a modality that can increase hamstring flexibility.

According to Ferreira *et al*., percussion based massage guns enhanced range of motion of multiple muscle groups, caused by reduced stiffness of muscles and increased extensibility of tissues. Percussion massage appears to function primarily as a flexibility-oriented intervention rather than a general performance enhancer[8,15] Similarly,

the current study supported the idea that percussion massage guns produces positive mechanical effects. Weerapong *et al*. outlined these changes which includes increasing blood flow, increased muscle relaxation and decreasing blood flow.[8]

The improvements concluded in our study are in agreement with the systemic review conducted by Sams *et al*. which indicated that acute gains in flexibility and reduction in perceived muscle tightness can be achieved by a bout to percussive therapy. The review highlighted percussive massage devices reduce muscle tone and increase local circulation, these mechanism parallel the responses observed in the population of recreational footballer.[13]

As highlighted by Ritzmann *et al*. vibration based therapy may influence neuromuscular signaling and muscle spindle activity which may lead to temporary reductions in muscle guarding and ease of movement. Localised vibrations decrease alpha motor neuron excitability leading to an increase in flexibility.[14]

In the study conducted by Clijsen *et al*., local skin temperature, speed of red blood cell movement, deep tissue blood flow and muscle oxygenation, was improved by application of percussion massage gun. Skin surface friction results in localized heating leading to microcirculation. [9] This leads to a cascade reaction in which cell mediators like prostaglandins and histamine are released from the mast cells causing a vascular response in the arterioles.[16] The increase in local body temperature and blood flow in deep tissue helps in increasing extensibility in muscle tissue.

Conclusion

The 5 minute percussion massage gun protocol demonstrated statistically significant effectiveness in immediately increasing flexibility of the hamstrings in young adult recreational footballers. This finding agrees with prior evidence that massage guns can acutely increase lower limb range of motion and reduce passive stiffness

Future Scope

Future studies can explore the duration of the therapeutic effects last to determine how long does the improvements in flexibility are sustained post treatment by percussive massage devices. Different percussion massage gun settings have different frequencies of vibration, possibly leading to subtle difference in flexibility gained which could be evaluated. Research should include larger and more diverse patient populations to validate these findings across different age groups, genders and clinical settings.

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