Métodos & Protocolos

Effect of shoulder internal rotators strengthening versus muscle energy technique for shoulder external rotators on bowling speed among fast bowlers playing cricket: a study protocol

Efeito do fortalecimento dos rotadores internos do ombro versus técnica de energia muscular para rotadores externos do ombro na velocidade de boliche entre jogadores rápidos que jogam críquete: um protocolo de estudo

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ABSTRACT | BACKGROUND AND PURPOSE: The literature has shown the promising effect on shoulder internal rotators strengthening on fast bowlers. However, no previous study has demonstrated the effect of muscle energy technique for shoulder external rotators on fast bowlers. This study aims to analyze the efficacy of shoulder internal rotators muscles strengthening and muscle energy technique for external rotators enhancing the bowling in speed among fast bowlers in cricket. **METHODS/DESIGN:** Participants will be screened based on the inclusion and exclusion criteria. Demographic data shall be collected. Participants taken shall be in the age group between 18-30 years, be randomly assigned into two groups: exercise group and MET group. Outcomes considered in the study are Universal Goniometer and Bowling speed km\h. This is a two-group, pre-test, post-test randomized clinical trial. Participants will receive 5 sessions per week within 2 months. The range of motion and speed of the ball is the primary outcome measures to the pre and post-intervention effect of the treatments. **PERSPECTIVES:** Results from this study can provide the basis for studying the strengthening of the shoulder internal rotator muscles and MET of shoulder external rotators in rehabilitation and clinical setups, which will provide additional help to the bowlers increase bowling speed. The procedure of the study is noninvasive, safe, and feasible. The efficacy of shoulder internal rotator strengthening and muscle energy technique for shoulder external rotators on fast bowlers in each group will be established with this study. **TRIAL REGISTRATION:** Clinical Trials Registry- India. (CTRI/2020/06/026046). Universal Trial Number- U1111-1257-4649.

KEYWORDS: Bowling. Cricket. Shoulder internal rotators. Shoulder external rotators.

RESUMO | JUSTIFICATIVA E OBJETIVO: A literatura tem mostrado efeito promissor no fortalecimento dos rotadores internos do ombro em atletas rápidos. No entanto, nenhum estudo anterior demonstrou o efeito da técnica de energia muscular para rotadores externos de ombro em arremessadores rápidos. O objetivo deste estudo foi analisar a eficácia do fortalecimento dos músculos dos rotadores internos do ombro e da técnica de energia muscular para os rotadores externos aumentando a velocidade do boliche entre jogadores de críquete. **MÉTODOS / DESENHO:** Os participantes serão selecionados com base nos critérios de inclusão e exclusão. Dados demográficos devem ser coletados. Os participantes escolhidos devem estar na faixa etária entre 18-30 anos, sendo distribuídos aleatoriamente em dois grupos. Grupo exercício e grupo MET. Os resultados considerados no estudo são Goniômetro universal e velocidade de boliche km \ h. Este é um ensaio clínico randomizado de dois grupos, pré-teste e pós-teste. Os participantes receberão 5 sessões por semana em 2 meses. A amplitude de movimento e a velocidade da bola são as medidas de resultado primárias para o efeito pré e pós-intervenção dos tratamentos. **PERSPECTIVAS:** Os resultados deste estudo podem fornecer a base para estudar o fortalecimento dos músculos do rotador interno do ombro e MET dos rotadores externos do ombro para serem usados na reabilitação e instalações clínicas que fornecerão ajuda adicional aos jogadores de arremesso para aumentar a velocidade do boliche. O procedimento do estudo é não invasivo, seguro e viável. A eficácia do fortalecimento dos rotadores internos do ombro e da técnica de energia muscular para os rotadores externos do ombro em lançadores rápidos em cada grupo será estabelecida com este estudo. **REGISTRO DE ENSAIO:** Registro de Ensaios Clínicos - Índia. (CTRI / 2020/06/026046). Número de teste universal - U1111-1257-4649.

PALAVRAS-CHAVE: Bowling. Cricket. Rotadores internos de ombro. Rotadores externos de ombro.

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Introduction

Cricket, a global sport played in more than 100 nations, is watched by billions of people worldwide, and top players can earn pound contracts every year. A growing passion for the sport has led to the professionalization of elite or even the first players who may play many matches in a year.[1] Among three established versions of the game, Twenty-twenty (T20) is a three-hour match, One Day (OD) is a six- to seven-hour match, and Multiday (MD) is a three- to five-day competition, performers may require different physical qualities. Cricketers will have a certain function in the squad, either batting or bowling (i.e., fast, medium, or slow speed), and fitness trainers will build fitness qualities based on these roles.[1] The bowler's release speed significantly impacts the delivery's outcome in cricket fast bowling.[2] A faster release speed shortens the batsman's judgment and stroke execution times, limiting the number of runs scored or increasing the chances of expulsion. In throwing sports, training with underweight and overweight implements (also known as modified-implement training) is a well-known way of enhancing release speed. While throwing a ball, the shoulder joint maintains the force generated from the trunk and legs.[3] Overhead throws by bowlers produce severe stress on muscles, ligaments, bones, and surroundings soft tissues. These stresses are highly related to glenohumeral joint pathologies. The glenohumeral joint regulates the maximum throwing motion by generating the high-velocity force and torque, which in turn causes severe stresses on the shoulder joint.[4] To develop a scientifically and biomechanically accurate bowling action, fast bowlers must follow a basic routine. The five critical sections in this sequence are the run-up, pre-delivery stride (back foot and front foot contact), ball release (inswing/outswing), and follow-through.[2,5]

While throwing a ball, the shoulder joint maintains the forces generated from the trunk and legs. Overhead throws by bowlers produce severe stress on muscles, ligaments, bones, and surroundings soft tissues.[6] These stress are highly related to glenohumeral joint pathologies.[3] Glenohumeral joint regulates the maximum throwing motion by generating the high-velocity force and torque, which in turn causes severe stresses on the shoulder joint.[3] It has been seen that fast bowlers have external and internal rotation deficits in their bowling hand when compared to their non-bowling hand.[7] The Glenohumeral, Sternoclavicular, Coracoclavicular, Acromioclavicular, and Scapulothoracic joints compose the shoulder complex, making it the most complicated joint in the human body.[3] The glenohumeral joint, which lacks bone support and compromises stability for enhanced mobility, is one of the most critical joints in shoulder movements. The glenohumeral ligaments, glenoid labrum, shoulder capsule, and rotator cuff muscles offer stability to the glenohumeral joint.[3] The external rotator strength is said to be roughly 65 percent that of the internal rotator. Internal shoulder rotators are involved in the acceleration phase of the arm during cricket bowling through concentric contractions, while external shoulder rotators are involved in the deceleration phase.[3] Fast bowling forces the arm to rotate at a rate of roughly 60000.s-1, putting much strain on the shoulder's integrity. Cricketers demand a high level of fitness in addition to technical ability, rendering them vulnerable to overuse injuries as a result of repetitive training. It has been seen that fast bowlers have external and internal rotation deficits in their bowling hands compared to their non-bowling hands. During bowling, the internal shoulder rotators are involved in the acceleration phase of the arm and the external rotators during the deceleration phase. With the release of time, repetitive throwing of the ball at high velocities leads to compromise of the shoulder joint, resulting in decreased ROM of the shoulder joint.[3] Decrease ROM of the GH joint leads to pain in the joint with inaction, which decreases the performance rate of cricket bowlers.[3] Various types of research have documented the internal rotation range to be much more decreased than external rotation in maximum players. Hence internal rotation decreases beyond the gain. Then external rotation is called the Glenohumeral Internal Rotation Deficit (GIRD). To our information, a significantly decreased internal rotation range of the shoulder is also seen in other sports.[3]

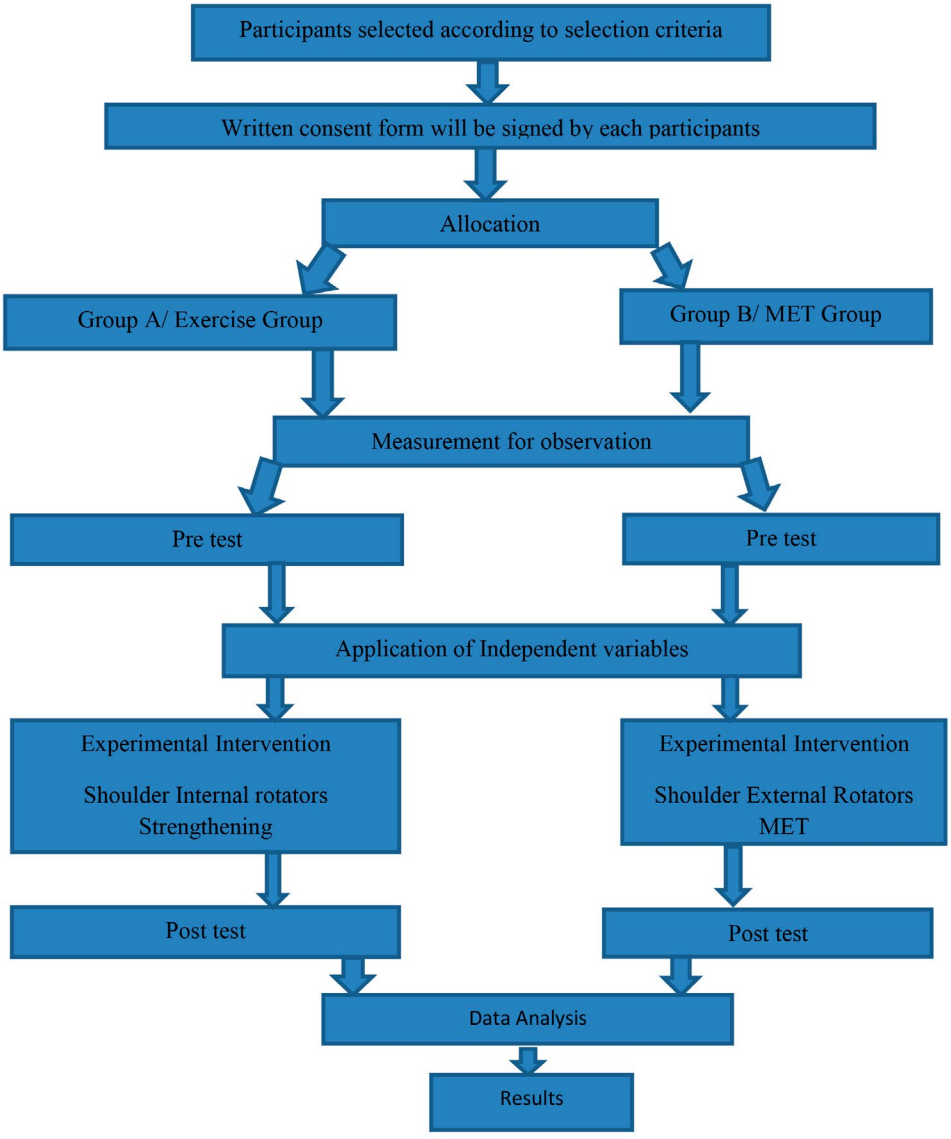
Traditionally Protection, Rest, Ice, Compression, and Elevation (PRICE) are used for avoiding tissue damage. However, the effective protocol is immobilization and rest of the joint. Low-intensity pulsed ultrasound and neuromuscular electrical stimulation are used for injury cricket players, especially bowlers. Commonly, active and passive range of motion exercises is performed by players to get more speed for bowling in their performance. To the best of the authors' knowledge, the research gap identified in the previously published literature is that they did not discuss the effect of shoulder internal rotator strengthening and MET for external rotators on fast

bowlers. The previous studies only targeted the superficial muscles, but this current study will focus on deep and superficial internal rotators and external rotators muscles. The null hypothesis is that there is no significant impact on the effect of shoulder internal rotator muscles strengthening on fast bowlers' bowling speed.

Furthermore, there is no significant effect of the muscle energy technique for shoulder external rotators on fast bowlers' bowling speed. The alternate hypothesis is a significant impact of shoulder internal rotator muscles strengthening on the bowling speed of fast bowlers playing cricket. There is a significant impact of muscle energy technique for shoulder external rotators on fast bowlers' bowling speed. Therefore, the objective of this randomized clinical trial will be to analyze the efficacy of shoulder internal rotators muscles strengthening and muscle energy technique for external rotators enhancing the bowling in speed among fast bowlers in cricket.

Material and methods

Figure 1. Flow chart for study protocol



The protocol was written according to the SPIRIT (Standard Protocol Items: Recommendations for Interventional trials) to improve the quality of the trial (Figure 1).[6]

Trial registration

The proposed study has been approved by the Institutional Research Ethics Committee (IEC). This study is registered at Clinical Trials Registry-India. (CTRI/2020/06/026046) on 23/06/2020 and Universal Trial Number-U1111-1257-4649. The trial will be conducted in the MM(DU) Sports ground in Sports Complex and Sports Research Laboratory in Physiotherapy department of Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India.

Study design

The proposed study is a two-group, pre-test post-test design. Fig. 1 demonstrates an overview of the protocol. Written consent forms for the voluntary participation of the patients will be taken. Every patient will be assured that there will be no harm, the information obtained from them will be used for research purposes, and their privacy will be maintained. The primary outcome measure will be the range of motion and bowling speed (kilometer/hour).

Participant's recruitment

Forty recreational bowlers will be recruited in the study according to selection criteria as mentioned in Table 1. Demographic data such as the name, age, gender, height, weight, occupation, address of each patient will be documented in a pre-designed proforma for the eligible patients. Detailed information about the participants is given in Table 1.

Table 1. Selection Criteria for participants

Inclusion criteria	Exclusion criteria
Male fast bowlers.	History of shoulder fracture.
Age between 18-30.	Open wound in the upper limb.
Bowlers without previous injury to the shoulder.	Previous Surgery to shoulder.

Randomization

A total of 40 eligible participants will be randomized to the Exercise and MET group via block randomization using the sequentially numbered opaque sealed envelope method. Blocks will have even numbers with a 4×10 (40) matrix, suggesting a total of four blocks with 10 rows. Subjects will then be allocated into each block using a random allocation sequence. After that, subjects will be allocated to the Exercise group (Internal rotator strengthening) and MET group (External rotators MET). Participants will be blinded to allocate in this study. The therapist conducted and assessed all procedures and outcome measures.

Interventions

The screening will be done to investigate contraindications related to the shoulder and cervical region. Before initializing any treatment, a baseline measurement will be taken. Next, all subjects will shoulder internal rotator strengthening and undergo external shoulder rotators muscle energy technique (MET), following which post outcome measurement will be taken on week 8. Then, Strengthening to Subscapularis, Teres major, Latissimusdorsi, and Pectoralis major muscles and MET will be given Deltoid, Supraspinatus, Infraspinatus, and Teres minor.

Subscapularis and Teres major Strengthening

Diagonal pattern: For the diagonal, the subject stood with his or her back to the wall, knees slightly bent, and feet shoulder-width apart in a split stance. The handle of the elastic resistance band was grasped at shoulder height with the elbow slightly flexed, and the humerus in the neutral position abducted to 90°. The subject then horizontally flexed, adducted, and internally rotated the humerus until the hand reached the anterior superior iliac spine opposite to that of the resistance. The humerus was progressively internally rotated 90° throughout the entire movement, beginning from the initial position and ending when touching the anterior superior iliac spine. Once the subject's hand touched the anterior superior iliac spine, he or she slowly returned to the starting position by externally rotating, horizontally extending, and abducting the humerus.[9]

LatissimusDorsi strengthening

Resistance Band Pull Backs and down

Begin this exercise in standing or kneeling with your back straight and holding a resistance band from the front of subjects. Slowly pull your arms backward, squeezing your shoulder blades together, and keeping your back and elbows straight, slowly pull the resistance band to your hips. Hold for 10 seconds and return to the start position.[9]

Pectoralis major strengthening

Resisted shoulder external rotation with a band from 45 degrees to 60 degrees with elbows flexed in 90 degrees and resisted "rowing" shoulder extension with elbow flexion with a band fixed on feet in the long sitting position. Resisted "rowing" shoulder extension with elbow flexion towards the abdomen with a band fixed on feet in the mini squat position.[10]

Shoulder external rotators Muscle Energy Technique (MET)

The therapist stabilized the shoulder at the acromion process with one hand and the other to passively move the subject's arm into internal rotation until the first motion barrier is reached. The subject is instructed to perform a 10 seconds isometric contraction of approximately 25% maximal effort in the direction of external rotation against opposing force provided at the distal forearm. The same pattern is to be followed against an opposing force provided at the distal forearm and the concerned arm's internal rotation. Active assisted stretched is applied. Stretch is maintained for 10 seconds.[11]

Subject position

The subject is in a supine position on the treatment couch, shoulder at 90-degree abduction and elbow at 90degree flexion.[11]

Outcome Measures

All outcomes will be assessed at baseline and 2 and 4 weeks after the intervention, with a follow-up assessment 4 weeks later. Therefore, all instruments used for assessment during the intervention should have good validity and reliability. Here, outcome measures will be assessed using a universal goniometer, and a radar gun will measure bowling speed.

Range of Motion

The range of motion measurements will be taken using a goniometer to measure shoulder internal and external rotation in both the dominant and non-dominant arms during the testing period. Measurements will be taken with each athlete lying in the lateral decubitus position.[12] Testing was done in this position because when lying supine, the humeral head is more likely to glide forward in the glenoid cavity-causing irritation in the anterior shoulder and leading to more inaccurate measurements as the athlete can compensate for lack of range of motion through the anterior or posterior rotation of the shoulder.[13] In the lateral decubitus plane, the humeral head is in a more advantageous position to externally and internally rotate without the humeral head glide. The investigator performing this part of the study was a certified strength and conditioning coach with seven years of experience and specifically trained in measuring the shoulder's range of motion using standard tools. Once the athlete is in the appropriate position, the investigator passively moves the arm until tension reaches and measurements were taken. The Intraclass Correlation Coefficient (ICC) of a trained clinician performing a total range of motion tests of the shoulder has proven reliable.[13]

Bowling speed measurement

Measuring bowling speed by a radar gun is similar to measuring the speed of a moving car. Also known as a speed gun, the speed measuring equipment consists of both a transmitter and a receiver.[14] It measures speed by sending a radio wave reflected by the object along its path. In this case, it is a cricket ball. The gun receives this echo and applies the principle of the Doppler Effect (the change in wavelength or frequency of a wave as it approaches or moves away from the observer), and calculates the speed of the ball.

Data monitoring

An independent researcher will perform all the statistical analyses and datasets. A treating physiotherapist will monitor the treatment sessions of each group.

Follow up

Call the patient for follow-up. Follow-up will be after 2 months of sessions. After that, the therapist will encourage the patients on the phone to visit for the follow-up on decided dates.

Sample size calculations

The sample size was calculated using the G*power tool. Internal rotation range of motion (ROM) values for studies related to healthy fast bowlers were considered. Mean pre-20.7 and mean post- 32.08, effects size- 1.13. The level of significance will be set at 0.05. To obtain a power of 95%, a sample size of n=14 in each group. Moreover, considering a 30% dropout rate, a final sample of n=20 in each group will be needed.[15]

Analysis of data

All data will be collected and analyzed by the researcher. Baseline characteristics of eligible participants will be presented using descriptive statistics. The normality of the collected data will be established using the Shapiro-Wilk test. Descriptive statistics will be expressed as Mean ± standard deviation or median and intra-quartile range based on data normality. Within-group comparisons will be conducted using paired t-tests or the Wilcoxon signed-rank test, while the between-group comparisons will be conducted using an independent t-test or the Mann-Whitney U-test. The level of significance was set at 0.05 for all analyses. Statistical analysis will be performed using the IBM SPSS statistical software version 20.

Perspectives

Fast bowling in cricket is a dynamic activity. In fast bowling, a bowler requires vigorous activity of both upper limbs and lower limbs. Bowlers' success is mainly dependent on their bowling speed because batters have minimal time to judge a ball to play it. The objective of the present study is to impel the effect of shoulder strengthening exercise of internal rotator muscles versus the Muscle Energy Technique

of external rotators on the bowling speed of fast bowlers playing cricket. The study will be conducted for one year. This present study will indicate that shoulder internal rotator muscles strengthening and external rotator MET might be effective for fast bowlers playing cricket.

To date, there is a lack of evidence for the effects of shoulder internal rotators muscle strengthening and muscle energy technique of shoulder external rotators responsible for bowling speed on fast bowlers on cricket. Muscle strengthening and MET are effective for cricket bowlers. Therefore, this study will help correlate strength and MET of shoulder internal and external rotators, which affect the bowling speed of fast bowlers in cricket.

Author contributions

Singha P participated in study conception and design, acquisition, analysis, and interpretation of the data, drafting the manuscript, and approval of the final version after revisions. Kumar P participated in study conception and design, analysis and interpretation of the data, and approval of the final version after revisions. Chahal A participated in study conception and design, acquisition, analysis, and interpretation of the data and approval of the final version after revisions.

Competing interests

No financial, legal, or political competing interests with third parties (government, commercial, private foundation, etc.) were disclosed for any aspect of the submitted work (including but not limited to grants, data monitoring board, study design, manuscript preparation, statistical analysis, etc.).

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