KABAT TRAINING PROGRAM IN DIAGONAL PATTERN WITH ELASTIC BANDS FOR SHOULDER IN AMATEUR SWIMMERS. A RANDOMIZED CONTROLLED CLINICAL TRIAL

THERA2020

NCT ID NOT YET ASSIGNED

MAY 2023

ABSTRACT

Introduction. The aim of the application of proprioceptive neuromuscular facilitation (PNF) stretching techniques with Theraband® is to improve muscle strength, the range of movement, and the muscular balance of the shoulder in swimmers. The training helps balancing the strength differences between external rotators and internal rotators muscles of the shoulder.

Aim. Analyze the efficacy of the proprioceptive neuromuscular facilitation training with Theraband ®on muscle strength, range of movement and muscular balance of rotator cuff in male swimmers.

Study design. Randomized clinical trial, prospective, single blind.

Methods. All 30 patients will be randomly divided into two groups, experimental and control, through a blinded process with opaque envelopes. The treatment will last 8 weeks with two sessions per week of 4 minutes each. The analyzed variables will be muscle strength (Manual Dynamometer) and the range of motion (goniometer). A descriptive statistical analysis will be performed, calculating the main statistical characteristics. Through the Kolmogorov – Smirnof analysis the normality will be calculated, and through the Pearson correlation test will be calculated the correlation between variables.

Expected results. After the treatment period the intention is to observe an improvement of the external rotator muscles strength of the shoulder as so of the range of motion and muscular balance of the shoulder joint.

Keywords. swimming; Strength; Proprioceptive Neuromuscular Facilitation; Rotator Cuff; Elastic Bands.

1. INTRODUCTION

1.1. INTRODUCTION

In swimming, the upper limbs, and more precisely the rotator cuff, are responsible for adduction and internal rotation movements, allowing the movement of the swimmer's body in the aquatic environment. This overuse of the internal rotators and adductors causes an imbalance of forces in these athletes compared to the external rotators and abductors of the shoulder. Imbalances between these antagonistic muscle groups are responsible for the incidence of rotator cuff injuries or "swimmer's shoulder" (1).

Strength exercises, as well as muscle stretching exercises, have always been integrated into the training of different disciplines to improve the performance of athletes (2). It would therefore be advisable to develop protocols for the prevention of shoulder injuries due to these muscular imbalances, strengthening the muscles responsible for external rotation and abduction of the shoulder (1).

1.2. ETIOLOGY, PREVALENCE AND INCIDENCE

The shoulder is the joint with the greatest degree of movement in the whole body, consequently, the incidence of injuries is very high. In the so-called “ overhead athletes ”, which include swimmers, among others, injuries to this joint complex have a high prevalence rate (3).

Swimmer's shoulder pain has an incidence rate of 38%. Between 29% and 91% of these athletes have suffered from this symptom throughout their sporting life (4). This data is easily explained since in the water the propulsion forces are based on the impulse through the upper limbs, unlike sports practiced on land where the lower limbs are used preponderantly. The overuse of the shoulder muscles during weekly training sessions,

which can be up to 6 or 7 per week, leads to muscular imbalances between the rotators, which, without preventive treatment, can later lead to injury (3).

1.3.PHYSIOTHERAPY TREATMENT

The most used techniques to increase the strength and muscular balance of the rotator cuff in overhead athletes include scapulohumeral stabilization exercises, plyometrics, maximum strength and electrotherapy application. In recent years, some studies have been published demonstrating the efficacy of resistance exercises with Theraband elastic bands® following a diagonal, PNF type pattern of Kabat, mainly analyzing sports that involve biomechanics similar to swimmers´, such as handball, volleyball and baseball. Compensatory training with the diagonal Kabat pattern with Theraband ® has shown positive effects in improving rotator cuff strength. (1, 5, 6, 7, 8, 9, 10).

1.4.THERABAND® TREATMENT

Scientific evidence demonstrates the effectiveness of Kabat diagonal training using the Theraband® following a strength training protocol with progression of external resistance. The elastic bands used ranged from a minimum resistance that corresponded to the yellow color, to the maximum of gold color. In general, the protocols were 6 weeks long, consisting of 3 series of 10 repetitions, 2 times a week. During the execution of the repetitions, the subjective perception of effort (SPE) of each patient was evaluated. When the SPE had a value equal to or less than 6, the repetitions were increased up to a maximum of 25, subsequently increasing the resistance by changing the elastic band. The position of the patients varied according to the studies. In order to avoid compensation of the thorax, the sitting position was the most frequent position

chosen. Regarding the fixation point of the elastic band, this varies in 3 points according to the study: head, feet and iliac crest. There is no single consensus in the current literature indicating protocols applied exclusively to swimmers, but most studies focus on overhead type athletes (1, 5, 6, 7, 8, 9).

1.5. JUSTIFICATION OF THE STUDY

The rotator cuff has enormous biomechanical importance in the swimmer's sporting gesture, also leading to a high incidence of injuries (1,4,5) . Exercises with Theraband® following a diagonal Kabat pattern to work on strength in all ranges of motion that involve external rotation can have compensatory effects for the overuse of the antagonist musculature, improving joint range of motion. The evidence shown in other overhead sports , with similar biomechanics, supports the idea of benefit in preventing injuries in swimmers. If a beneficial effect is demonstrated in athletes, its inclusion in the training routine of swimmers would be simple, given the ease of application of this technique, the versatility and the short time required to carry out this training at a minimum cost of money (1, 5, 6, 7, 8, 9).

2. HYPOTHESIS

CONCEPT HYPOTHESIS.

- Theraband® training produces significant improvements in external rotator muscle strength, range of motion, scapular displacement, and rotator cuff muscle balance in amateur swimmers.

NULL HYPOTHESIS.

- Theraband® training does not produce statistically significant effects on lateral rotator muscle strength, range of motion, scapular displacement, and rotator cuff muscle balance in recreational swimmers.

ALTERNATIVE HYPOTHESIS.

- Theraband® training produces statistically significant effects on lateral rotator muscle strength, range of motion, scapular displacement, and rotator cuff muscle balance in recreational swimmers.

3. OBJECTIVES OF THE STUDY

MAIN GOAL

- To evaluate the effectiveness of the application of Theraband® techniques on the strength of the external rotator muscles of the rotator cuff of the shoulder in amateur swimmers between 18 and 33 years of age.

SECONDARY OBJECTIVES

- To evaluate the effectiveness of the application of Theraband® techniques on the range of motion of the shoulder in amateur swimmers between 18 and 33 years of age.
- To evaluate the effectiveness of the application of Theraband® techniques on the scapular displacement of the shoulder in amateur swimmers between 18 and 33 years of age.
- To evaluate the effectiveness of the application of Theraband® techniques on the muscular balance of the rotator cuff of the shoulder in amateur swimmers between 18 and 33 years of age.

4. METHODOLOGY

4.1. STUDY DESIGN

randomized controlled clinical trial conducted in amateur swimmers between 18 and 33 years of age, with the objectives of determining if PNF training with the Theraband® is effective on increasing shoulder external rotator strength, range of motion, and muscular balance of the rotator cuff of the shoulder in these subjects.

4.2. SAMPLE RECRUITMENT

Swimmers will be recruited from the following clubs: Royal Spanish Swimming Federation (Madrid) and Universidad Europea de Madrid. After presenting the research project to the directors and managers of the clubs, the athletes of the clubs will be informed verbally and in writing of the objectives and purposes of the study.

Subjects who agree to participate in this clinical trial will be evaluated to determine whether or not they meet the inclusion criteria, they will be given the informed consent form to sign and successively they will be randomized into two groups, the experimental and the control group.

4.3. SELECTION CRITERIA

Subjects with the following characteristics will be included in this study: male swimmers, belonging to an age range between 18 and 33 years; and that they are training at least two days per week.

In the same way, those subjects who present acute infections, those who suffer from shoulder pathologies and those who have not signed the informed consent document will be excluded.

4.4. SAMPLE SIZE JUSTIFICATION

sample size with respect to the samples used in studies carried out prior to this publication with a similar research objective.

4.5. SAMPLE RANDOMIZATION

Study participants who have signed the informed consent and who meet the inclusion criteria will be randomized. Subjects will be randomly assigned to the respective groups through opaque envelopes.

The athletes belonging to the experimental group will carry out PNF training with Theraband®, while those in the control group will not carry out any type of training.

The physiotherapist in charge of carrying out the test measurements (pre and post treatment) will be blinded regarding the assignment of the participants to the two study groups.

4.6. OUTCOME MEASURES

After receiving the informed consent signed by the athletes, the pre-treatment evaluation will be carried out in the aforementioned centers and included in this study. The measurement will be performed by a physiotherapist blinded to the investigation.

After the treatment period, the study participants from both groups (experimental and control) will be assessed again by the same investigator, following the same guidelines as the initial assessment.

In the different study evaluations, 4 variables will be measured: the maximum isometric force of shoulder in external rotation, the range of joint movement, the scapular displacement and the muscular balance between external and internal rotators of the shoulder. The outcome measures used for these variables will be:

- Assessment of the maximum isometric strength of the external and internal rotators of the shoulder joint complex. An assessment will be made with the modified sphygmomanometer test validated by Chamorro et al. (2021) (11). It will be used according to the protocol indicated by Souza et al. (2014) (12). Before starting the test, the entire procedure will be explained to the subject, time will be allowed for them to familiarize themselves with the dynamometer and they will have 3 minutes to warm up before starting with 2 test series at minimal effort (13). The unit of measurement of this instrument is the applied force, indicated in Newton (N) (12). The subject will be placed in a supine position on a table, with the trunk held by velcro straps to ensure stability during the test and avoid possible compensation. The subject's upper limb to be evaluated will be placed in a shoulder abduction and 90° elbow flexion, the forearm will be perpendicular to the floor and to the table. The dynamometer will be placed transversely to the distal end of the upper limb, in contact with the patient's wrist, requesting 5-6 series of maximum isometric contractions, for 5 seconds, with 30 seconds of rest between series, respectively in external rotation position and internal. The exerted force will be indicated by the dynamometer and the maximum value reached during each series will be recorded. If the values reached in the 5 contractions exceed a coefficient of variation of 5% or if a pain threshold of 6/10 of the visual analogue scale (VAS) is exceeded, the test must be repeated to guarantee its validity. During the execution of the series, the physiotherapist will maintain firm contact with the dynamometer, applying a resistance parallel to and equal to the force applied by the subject, without allowing the upper limb to move. The patient will be verbally stimulated to make maximum effort during the 5 seconds and the subject will be instructed not to use the Valsalva maneuver during the execution of the test (13).

At the end of the test, the result obtained will be recorded. A higher score indicates a greater application of muscular force (12).

- Joint range of motion in external rotation. The patient will be placed in the supine position on a table with the arm stabilized and a towel placed below the humerus to maintain a position of the arm 10/15° anterior to the coronal plane (in the scapular plane). The patient's arm will be in a 90° shoulder abduction position, the elbow outside the table at 90° flexion, the forearm and wrist in a 0° position (perpendicular to the table and the floor). To carry out the measurement, a goniometer (Tandou_1AA800252®) will be used. The axis will be placed over the central part of the acromion. The fixed arm of the goniometer will be positioned aligned with the vertical perpendicular to the ground, while its mobile arm will be superimposed on the fixed arm, aligned with the longitudinal midline between the ulna and its styloid process (14).
- Rotator cuff muscle balance: with the results of the maximum isometric strength assessment, we will make a ratio between internal and external rotators of each arm (maximum internal rotation isometric force / maximum external rotation isometric force), a value closer to 1 will indicate a better muscular balance (15).
- Scapular displacement: in standing position, the horizontal distance between the inferior angle of the scapula and the corresponding thoracic spinosa is measured in the relaxed position as a baseline measure, and the horizontal displacement of the angle at maximum elevation of the arm is measured using the PALM(16) .
- inter-observer reliability analysis will be performed . The principal investigator and the evaluator will evaluate the maximum isometric force of the external rotators of the shoulder and the angle of optimal application of force in a sample of 5 subjects.

4.7. INTERVENTION

Each session will last approximately 4 minutes per subject, taking place 2 days a week, over a period of 8 weeks. The intervention will be carried out at the beginning of the training session.

Prior to the realization After swimming training, the strength technique with Theraband® will be applied to the subjects of the experimental group, asking the control group to follow their usual routine.

The Theraband® intervention will consist of the application of the protocol described by Batahla et al. 2015(1). The objective of the application of the technique is to produce an increase in muscle strength in the external rotators and the optimal angle of force application. The technique will be performed with the patient in a standing position lateral to a wall bar where the elastic band will be fixed at the level of the iliac crest. Each repetition will consist of bringing the end of the elastic band following the diagonal pattern of Kabat D2 for the flexion. It will start from a position of adduction, extension and internal rotation of the shoulder with elbow extension and pronation, flexion and ulnar tilt of the wrist until reaching a position of flexion, abduction and external rotation of the shoulder with elbow extension and supination, extension and radial bend of the wrist. The elastic bands used will have different resistances depending on the color. 2 types of bands will be used respectively from lower to higher resistance. There will be 3 series, of 10 repetitions each, for each upper limb. At the end of each series, the subjective perception of effort of each patient will be evaluated (from 0 to 10), and in the event that it reaches a value equal to or less than 6, 5 repetitions will be added in each series until reaching a maximum. of 20 or SPE greater than 6. When 20 repetitions are reached, the resistance of the Theraband® will be increased by changing the elastic band in the next session, starting again with 10 repetitions (1).

Subjects will be properly instructed in performing the exercises at the start of the protocol by physiotherapists and/or qualified trainers previously trained by the authors.

5. STATISTICAL ANALYSIS PLAN

Descriptive analysis will be conducted to characterize the sample. Central tendency and dispersion data will be reported as mean and standard deviation for normal-distributed variables, or as median and interquartile range for non-normal- distributed variables, respectively. For the quantitative variables, the independent t-test or the Mann–Whitney U test will be carried out to compare the mean groups at the baseline. The homoskedasticity and sphericity will be checked. A mixed analysis of variance (ANOVA) 3 × 2 was carried out, adjusting multiple comparisons with the Bonferroni test. The size of the effect will be estimated with partial eta squared (η 2), interpreting values of 0.01, 0.06, 0.14, as small, medium, and large, respectively.

6. BIBLIOGRAPHY

1. Batalha N, Raimundo A, Tomas-Carus P, Paulo J, Simão R & Silva AJ. Does a land-based compensatory strength-training programme influences the rotator cuff balance of young competitive swimmers? *Eur J Sport Sci.* 2015;15(8):764-72.
2. Costa e Silva G, Silveira A, Novaes J, Di Masi F, Conceição M, Dantas E. Acute effects of static and propioceptive neuromuscular facilitation Stretching on sprint performance in male swimmers. Med Sport. 2014;67:119-128.
3. Kluemper M, Uhl T & Hazelrigg H. Effect of Stretching and Strengthening Shoulder Muscles on Forward Shoulder Posture in Competitive Swimmers. *J Sport Rehabil*. 2006;15, 58-70.
4. Walker H, Gabbe B, Wajswelner H, Blach P, Bennell K. Shoulder pain in swimmers: a 12 month prospective cohor study of incidence and risk factors. *Phys Ther Sport*. 2012 Nov,13(4):243-249.
5. Batalha N, Marmeleira J, Garrido N, Silva AJ. Does a wáter training macrocycle really create imbalance in swimmers' shoulder rotator muscles? *Eur J Sport Sci.* 2015;15(2): 167-172.
6. Witt D, Talbott N, Kotowski S. Electromyographic activity of scapular muscles during diagonal patterns using elastic resistance and free weights. *Int J Sports Phys Ther*. 2011 Dec; 6(4): 322-332.
7. Richards JA, Dawson TA. Optimizing excercise outcomes: the efficacy of resistance traning using conventional vs. novel movement arcs. *J Strength Cond Res*. 2009 Oct; 23(7): 2015-24.
8. Swanick KA, LephartSM, Swanick CB, Lephart SP, Stone DA, Fu FH. The effects of shoulder plyometric training on propioception and selected muscle performance characteristics. *J Shoulder Elbow Surg*. 2002 Nov-Dec; 11(6):579-586.

9. Page PA. Posterior rotator cuff stregthening using Theraband(r) in a functional diagonal pattern in collegiate baseball pitchers. *J Althl Train*. 1993; 28(4): 346-354.
10. Matthews MJ, Green D, Matthews H, Swanwick E. The effects of swimming fatigue on shoulder strength, range of motion, joint control, and performance in swimmers. *Phys Ther Sport*. 2017 Jan;23:118-122.
11. Chamorro C, Arancibia M, Trigo B, Arias-Poblete L, Jerez-Mayorga D. Absolute Reliability and Concurrent Validity of Hand-Held Dynamometry in Shoulder Rotator Strength Assessment: Systematic Review and Meta-Analysis. Int J Environ Res Public Health. 2021 Sep 3;18(17):9293. doi: 10.3390/ijerph18179293. PMID: 34501883; PMCID: PMC8430567.
12. Souza LA, Martins JC, Moura JB, Teixeira-Salmela LF, De Paula FV, Faria CD. Assessment of muscular strength with the modified sphygmomanometer test: what is the best method and source of outcome values? *Braz J Phys Ther*. 2014 Mar-Apr;18(2)191-200.
13. Polito, M.C., Simão, R., Nobrega, A.C.L., Farinatti PTV. Pressão arterial, frequência cardíaca e duplo-produto em séries sucessivas do exercício de força com diferentes intervalos de recuperação. *Revista Portuguesa de Ciẽncias do Desporto.* 2004;3(4):7-15.
14. Manske R, Wilk KE, Davies G, Ellenbecker T, Reinold M. Glenohumeral motion deficits: Friend or foe? *Int J Sports Phys Ther* 2013;8:537-553.
15. McLaine SJ, Ginn KA, Fell JW, Bird ML. Isometric shoulder strength in young swimmers. *J Sci Med Sport* . 2018 Jan;21(1):35-39.
16. da Costa BR, Armijo-Olivo S, Gadotti I, Warren S, Reid DC, Magee DJ. Reliability of scapular positioning measurement procedure using the palpation meter (PALM). Physiotherapy. 2010 Mar;96(1):59-67.