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OPINION ARTICLE

The importance of anatomical knowledge and execution technique for optimizing strength training results: opinion article

A importância do conhecimento anatômico e da técnica de execução para otimização dos resultados do treinamento de força: artigo de opinião

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Abstract

Strength training is essential for maintaining and optimizing health and is an effective non-pharmacological resource in the treatment of various comorbidities. The repercussions revolve around the promotion of motivated adaptations due to the planning and structuring of the training program through the manipulation of variables such as intensity, volume, selection and order of exercises, weekly frequency, cadence, and amplitude. These include the manipulation of variables such as intensity, volume, exercise selection and order, recovery interval, weekly frequency, cadence, and amplitude. This study aims to discuss the importance of anatomical knowledge and the use of an appropriate execution technique, which must be applied in strength exercises. However, what can be observed in practice is a lack of methodology, as well as an undefined movement standard of exercises, which is based on the premise of improving body composition. In this context, the study points to the need for a more robust discussion on the movement standard and the application of an adequate execution technique in three exercises commonly prescribed in physical training programs. Implementing a proper execution technique based on origin, muscle and joint insertion and actions could optimize strength, hypertrophy, and weight loss results.

And, since improving these components is related to a reduction in comorbidities, there is a need for studies that discuss the role of movement execution in greater depth. Thus, further research could evoke a debate on the feasibility of incorporating execution technique as the eighth variable in muscle strength training.
Keywords: Physical exercise; physical training; body composition.

Resumo

O treinamento de força é essencial para a manutenção e para otimização da saúde, sendo um recurso não-farmacológico eficaz no tratamento de variadas comorbidades. As repercussões giram em torno da promoção de adaptações motivadas em função do planejamento e da estruturação do programa de treinamento através da manipulação das variáveis tais como, intensidade, volume, seleção e ordem dos exercícios, intervalo de recuperação, frequência semanal, cadência e amplitude. O presente estudo tem como objetivo discutir a importância do conhecimento anatômico e a utilização de uma adequada técnica de execução que deve ser aplicada de maneira imprescindível nos exercícios de força. Todavia, o que se observa na prática é uma negligência metodológica, além de uma indefinição no padrão de movimento dos exercícios que tem como premissa a melhoria da composição corporal. Nesse contexto, o estudo aponta a necessidade de uma discussão mais robusta sobre o padrão de movimento e a aplicação de uma adequada técnica de execução em três exercícios comumente prescritos em programas de treinamento físico. A implementação de uma técnica de execução adequada com base na origem, inserção e ações musculares e articulares poderia otimizar os resultados de força, de hipertrofia e de emagrecimento. E, uma vez que a melhoria desses componentes está relacionada à redução de comorbidades, é necessário estudos que discutam com maior profundidade o papel da execução do movimento. Desta forma, novas pesquisas poderão abrir espaço para debates em relação à viabilidade da incorporação da técnica de execução como a oitava variável do treinamento de força muscular.
Palavras-chave: Exercício físico; treinamento físico; composição corporal.

This article expresses the author's opinion on the subject, exempting the journal from any responsibilities. Although a peer review was conducted, the thought expresses here may be refuted.

Esse artigo expressa a opinião do autor sobre a temática eximindo qualquer responsabilidade da revista. Embora tenha sido realizada uma avaliação por pares o pensamento aqui expresso pode ser refutado.

Introduction

Strength training is one of the non-aerobic components of physical fitness [1], making it essential for optimizing and maintaining health. As an efficient and safe tool for preventing and

treating various chronic diseases [2,3], strength training is considered a non-pharmacological treatment and should be included in physical training programs [4].

This non-aerobic component [1] can be performed in the form of weight training and one of its benefits is muscle strength increase, i.e. greater activation of motor units, also known as increased mind-muscle connection, helping with muscle hypertrophy and weight loss [5]. Physical training can improve the immune system [6], metabolic system [7], cardiorespiratory system [8], and various other body systems, providing greater autonomy and quality of life for different population profiles, such as the elderly [9]. It can also be used for specific recovery/rehabilitation or prevention of osteomioarticular injuries [10].

The main variables in strength training include intensity, volume, exercise selection and order, recovery interval, weekly frequency, cadence, and range of motion [11]. Thus, to optimize the benefits of strength training, this opinion article advocates that execution technique should be an essential variable for the development of strength, hypertrophy, and protocols focused on weight loss, among other objectives mentioned above [11].

Considerations on the execution technique

To better direct the force to the target muscle and reduce the contraction of the auxiliary muscles, also known as secondary motor muscles, it is essential to have a technical-scientific knowledge of the anatomy and joint functionality of the scapular and pelvic girdles. Mastering these concepts is essential to enhance the contraction of the target muscles. In addition, to build the right motor gesture, a standardized order of joint and muscle actions is needed so that in exercises such as the bent-over row, the biceps brachii is not the most requested and most fatigued muscle in training programs focused on hypertrophy or weight loss.

For such, exercise professionals or trainers must master anatomical concepts such as origin, insertion, as well as the respective muscle and joint actions. Thus, it would be more appropriate to have guidance and supervision from the professional responsible for the movement so that the correct verbal instruction regarding the sequence of joint and, consequently, muscle actions would lead to the optimum execution of the movement.

This guidance and monitoring is essential, since unfortunately we see individuals in gyms and training centers with little or no technical aptitude in the various muscle strength exercises, when the main objective is to improve body composition. Thus, to provide a better theoretical and practical understanding, three exercises are explained in Figures 1 and 2. However, the same premise regarding anatomical concepts, and joint and muscle actions must be taken into account in other exercises. However, a more in-depth discussion would be necessary, and future studies would be needed for this.

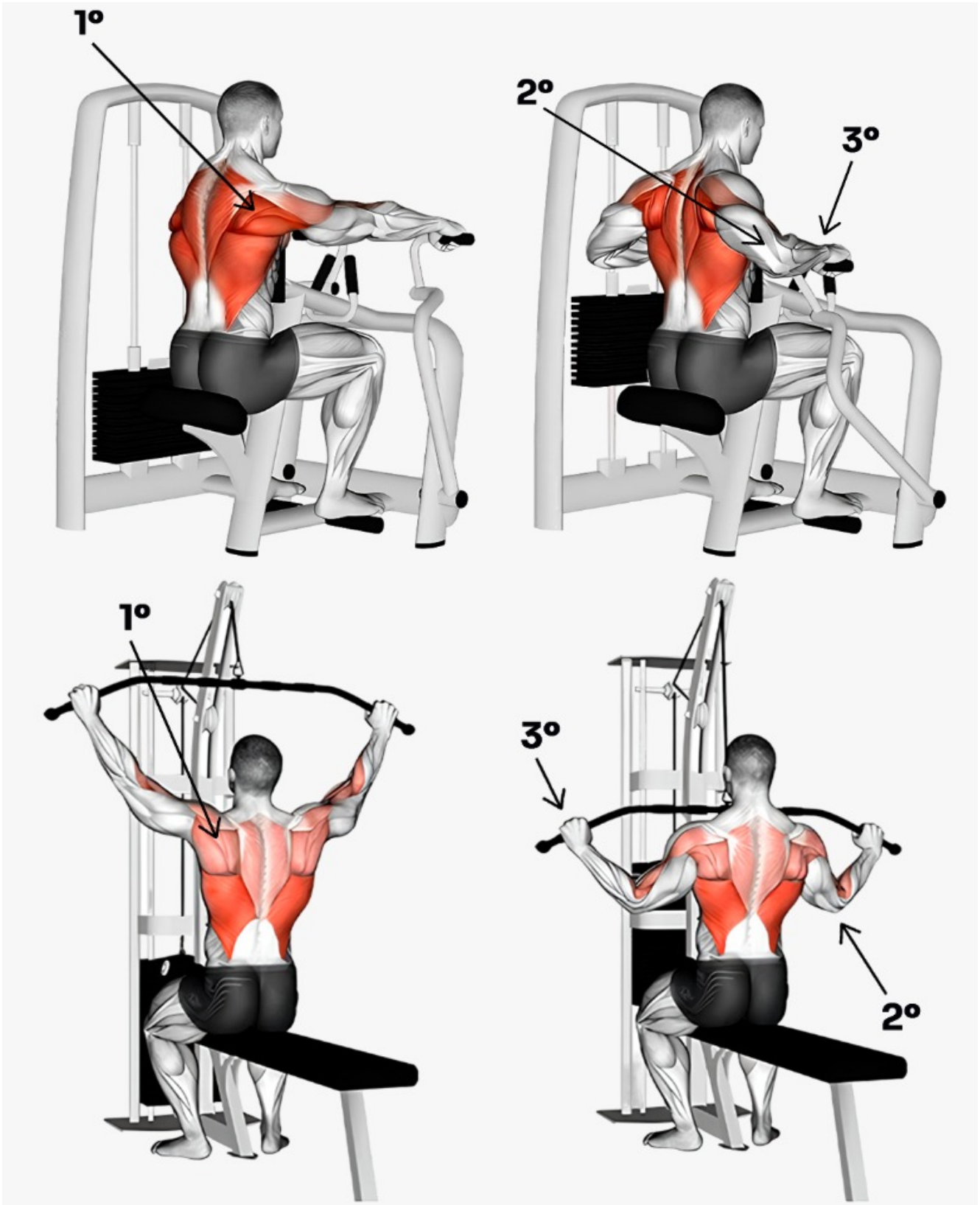

Figure 1 - *The drawing represents the rowing exercise on the machine on the left, and the front pull-down on the machine on the right, where both executions of the movement are determined by a specific joint and muscle order. In the concentric phase, the numerical order of activation is ascending and, in the eccentric phase, it is descending.*

In machine rowing, the first movement of scapular adduction directs the force to the posterior muscles. Next, the second movement takes place by flexing the elbows to enhance the muscle contraction initially performed by scapular adduction. The third phase of the movement takes place in the distal part of the articulation, where the wrist joint is located. It is important to note that throughout the movement where the full action of scapular adduction takes place, the performer must extend the thoracic spine, which is a structure of mobility to enhance muscle contraction. The pelvis should be in an anterior pelvic tilt position to activate the origin of the dorsalis, which is attached to the sixth and seventh vertebrae of the thoracic spine, the thoracolumbar fascia, and, inferiorly, the iliac crest. In the concentric phase, the order of joint and muscle actions is increasing, as shown in the figure, and, in the eccentric phase, it will be decreasing, i.e. inversely proportional. First with the distal part, which is the wrist, followed by the elbows, and, finally, the scapulae. It is necessary to maintain constant contraction throughout concentric and eccentric movements to ensure the time under muscle tension and, consequently, the benefits and improvements related to body composition [5].

As with the rowing, the machine pull-up will have similar mechanics. However, instead of adduction, the first movement in the pull will be scapular depression, which will be possible because of the trapezius muscle. This muscle is divided into three parts. The upper portion actively raises the shoulder. The middle portion controls the rotation of the scapula during elevation of the upper limb. The lower portion is responsible for the rotational force and depression of the scapula. It is worth noting that, with the scapular depression movement, the muscle contraction to pull the bar will not be emphasized by the biceps brachii. Thus, this secondary motor muscle will not fatigue before the target muscle, which should be the dorsal muscle. The second movement will occur by flexing the elbows towards the ribs to enhance the muscle contraction initially performed by the scapular depression. The third phase of the movement will take place in the distal part of the articulation, where the wrist joint is located, which will complete the conduction until the end of the movement, favoring the direction of the elbows against the ribs and, consequently, the direction of the force. It is noteworthy that throughout the movement in which the complete action of scapular depression occurs, the performer must extend the thoracic spine, which is a mobility structure to globalize the possible joint actions (scapular depression and thoracic spine extension) in this exercise and enhance muscle contraction. The pelvis should be slightly tilted anteriorly to activate the origin of the dorsal muscle, just as it will in the rowing machine exercise. During the concentric phase, the order of joint and muscle actions is increasing, and, during the eccentric phase, it is decreasing, i.e. inversely proportional. First with the distal part, which is the wrist, followed by the elbows, and, finally, the scapulae. It is also necessary to keep the contraction constant throughout the concentric and eccentric movements to ensure the time under muscle tension.

Figure 2 - *The figure represents the lying leg curl exercise where the execution of the movement is determined by a specific joint and muscle order. The position adopted at the end of the construction of the motor gesture should be maintained and only the knee joint should move throughout the concentric and eccentric contractions*

In the lying leg curl exercise, the technical construction for executing the movement is also determined by a specific joint and muscle order. The first movement generated is adduction of the scapulae. The second movement is an extension of the thoracic spine. The sum of the first and second movements will stabilize the shoulder girdle. It is worth noting that the thoracic spine enables this joint function because it is a mobility structure, but the lumbar spine must maintain physiological lordosis because it is a stability structure. To correctly construct the motor gesture, the third movement is hip extension associated with the convergent contraction of the gluteus maximus. This detail will enhance the stability and proper positioning of the pelvic girdle. Finally, the fourth movement ends with knee flexion combined with plantar dorsiflexion to effectively contract the posterior thigh chain. The position adopted throughout the construction of the motor gesture must be maintained and only the knee joint will move throughout the concentric and eccentric contractions. It is necessary to keep the contraction constant throughout the concentric and eccentric movements to ensure the time under muscle tension, as in the two exercises mentioned above.

Final considerations

In addition to the technical explanations of the exercises, it is essential to outline some basic premises for building the proper motor gesture. For this purpose, we need to adopt four keys that have been discussed in the literature [12-14]. The first key is the concept of verbal instruction for greater muscle connection and, consequently, greater mentalization of the movement [12]. The second key is stabilizing the movement, which should be done through the core. Core stability is often discussed and associated with improved physical performance but there is not enough evidence about its role in specific performance [13] and this includes strength training which can be emphasized by the method called bodybuilding. The third key is the correct targeting of the force, as well as subjecting the muscle to the optimum time under tension if the focus is on improving body composition [14]. Finally, the fourth key is to globalize the possible joint and/or muscle actions that the target structure can exert during the execution of the movement to enhance the contraction and connection. A practical example of globalization is shown in figure 2, using hip extension and knee flexion to enhance muscle contraction and movement stability, thus avoiding undesirable pelvic anteversion. However, it is noteworthy that the same concept can be used in other exercises.

In short, the implementation of an appropriate execution technique could optimize the results of strength, hypertrophy [15], and weight loss [16]. And since improving these components is related to a reduction in comorbidities such as insulin resistance [17], diabetes *mellitus* [18], hypertension [19] and all-cause mortality [20], there is a need for more in-depth studies.In addition to all-cause mortality [20], there is a need for studies that discuss in greater depth the role of movement execution and, consequently, its respective technique. If the hypotheses are confirmed, further research could open the way to discussing and verifying the feasibility of incorporating execution technique as the eighth variable in muscle strength training.

Conflict of interest

The authors report no conflicts of interest.

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Authors' contributions

Conception and design of the research: Chaves, TO, Reis, MS; Manuscript writing: Chaves, TO, Reis, MS; Critical review of the manuscript for important intellectual content: Chaves, TO, Reis, MS.

References

1. Araújo CG. Aerobic and non-aerobic components of physical fitness: risk factors for all-cause mortality. Rev Factores Risco. 2015;35(1-3):36-42
2. Schoenfeld BJ, Grgic J, Ogborn D, Krieger JW. Strength and hypertrophy adaptations between low-vs. high-load resistance training: a systematic review and meta-analysis. J Strength Cond Res. 2017;31(12):3508-23. doi:10.1519/JSC.0000000000002200
3. Silva GA, Behm DG, Monteiro ER, Fiuza AG, Gomes TM, Vianna JM, et al. Order effects of resistance and stretching exercises on heart rate variability and blood pressure in healthy adults. J Strength Cond Res. 2019;33(10):2684-93. doi: 10.1519/JSC.0000000000002627

4. Mathisen TF, Rosenvinge JH, Friborg O, Vrabel K, Bratland-Sanda S, Pettersen G, et al. Is physical exercise and dietary therapy a feasible alternative to cognitive behavior therapy in treatment of eating disorders? A randomized controlled trial of two group therapies. Int J Eat Disord. 2020;53(4):574-585. doi:10.1002/eat.23228
5. Cornelis J, Beckers P, Taeymans J, Vrints C, Vissers D. Comparing exercise training modalities in heart failure: A systematic review and meta-analysis. Int. J. Cardiol 2016;221:867-876. doi:10.1016/j.ijcard.2016.07.105
6. Souza TS, Pfeiffer PA, Pereira J, Neto EA, Dutra T, Mendonça M, et al. Immune System Modulation in Response to Strength Training With Blood Flow Restriction. J Strength Cond Res. 2019. doi: 10.1519/JSC.0000000000003323. Online ahead of print
7. Wayne LW. Resistance training is medicine: effects of strength training on health. Curr Sports Med Rep. 2012;11(4):209-16. doi: 10.1249/JSR.0b013e31825dabb8
8. Green S, Kiely C, O'Connor E, Gildea N, O'Shea D, Egaña M. Effects of exercise training and sex on dynamic responses of O2 uptake in type 2 diabetes. Appl Physiol Nutr Metab. 2020;45(8):865-874. doi: 10.1139/apnm-2019-0636
9. Coelho-Júnior HJ, Gonçalves IO, Sampaio RA, Sampaio PY, Cadore EL, Calvani R, et al. Effects of Combined Resistance and Power Training on Cognitive Function in Older Women: A Randomized Controlled Trial. Int J Environ Res Public Health . 2020;17(10):3435. doi: 10.3390/ijerph17103435
10. Cheng R, Maloney A, Moran J, Newman TH, Gardner EC. Resistance Training as Treatment for Sarcopenia: Examining Sex-Related Differences in Physiology and Response. Clin Ther. 2022;44(1):33-40. doi: 10.1016/j.clinthera.2021.11.012
11. Lacio M, Vieira JG, Trybulski R, Campos Y, Santana D, Filho JE, et al. Effects of Resistance Training Performed with Different Loads in Untrained and Trained Male Adult Individuals on Maximal Strength and Muscle Hypertrophy: A Systematic Review. Int J Environ Res Public Health. 2021;26;18(21):11237. doi: 10.3390/ijerph182111237
12. Snyder BJ, Fry WR. Effect of verbal instruction on muscle activity during the bench press exercise.J Strength Cond Res. 2012;26(9):2394-400. doi: 10.1519/JSC.0b013e31823f8d11
13. Zemková E, Zapletalová L. The Role of Neuromuscular Control of Postural and Core Stability in Functional Movement and Athlete Performance. Front Physiol. 2022;13:796097. doi: 10.3389/fphys.2022.796097. ECollection 2022.
14. Krzysztofik M, Wilk M, Wojdała G, Gołaś A. Maximizing Muscle Hypertrophy: A Systematic Review of Advanced Resistance Training Techniques and Methods. Int J Environ Res Public Health. 2019;16(24):4897. doi: 10.3390/ijerph16244897
15. Lopez P, Radaelli R, Taaffe DR, Newton RU, Galvão DA, Trajano GS, et al. Resistance Training Load Effects on Muscle Hypertrophy and Strength Gain: Systematic Review and Network Meta-analysis. Med Sci Sports Exerc. 2021;53(6):1206-1216. doi: 10.1249/MSS.0000000000002585
16. Lopez P, Taaffe DR, Galvão DA, Newton RU, Nonemacher ER, Wendt VM, et al. Resistance training effectiveness on body composition and body weight outcomes in individuals with overweight and

obesity across the lifespan: A systematic review and meta-analysis. Obes Rev. 2022;23(5):e13428. doi: 10.1111/obr.13428

17. Green S, Kiely C, O'Connor E, Gildea N, O'Shea D, Egaña M. Effects of exercise training and sex on dynamic responses of O2 uptake in type 2 diabetes. Appl Physiol Nutr Metab. 2020;45(8):865-874. doi: 10.1139/apnm-2019-0636

18. Moro T, Tinsley G, Pacelli FQ, Marcolin G, Bianco A, Paoli A. Twelve Months of Time-restricted Eating and Resistance Training Improves Inflammatory Markers and Cardiometabolic Risk Factors. Med Sci Sports Exerc. 2021;53(12):2577-2585. doi: 10.1249/MSS.0000000000002738

19. Villafuerte FU, Cànaves JL, Montalvo PL, Sancho ML, Oliver BO, Flores FB, et al. Effectiveness of a multifactorial intervention, consisting of self-management of antihypertensive medication, self-measurement of blood pressure, hypocaloric and low sodium diet, and physical exercise, in patients with uncontrolled hypertension taking 2 or more antihypertensive drugs: The MEDICHY study. Medicine (Baltimore). 2020;99(17):e19769. doi:10.1097/MD.0000000000019769

20. Ekelund U, Tarp J, Steene-Johannessen J, Hansen BJ, Jefferis B, Fagerland MW, et al. Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. Meta-Analysis BMJ. 366:l4570. doi: 10.1136/bmj.l4570