ELBOW JOINT TRAINING IN TABLE TENNIS TEACHING

TREINAMENTO DA ARTICULAÇÃO DO COTOVELO NO ENSINO DO TÊNIS DE MESA

ENTRENAMIENTO DE LA ARTICULACIÓN DEL CODO EN LA ENSEÑANZA DEL TENIS DE MESA

Original Article
Artigo Original
Artículo Original

Danyang Liu[1]
(Physical Education Professional)

1. Beijing Sport University, Haidian, Beijing, China.

Correspondence:
Danyang Liu
Haidian, Beijing, China. 100084.
wo9o9o9@126.com

ABSTRACT

Introduction: Table tennis is widely acclaimed by the public and is also one of the most popular activities chosen by Chinese athletes. However, many athletes only pay attention to learning sports skills in sports training and neglect muscle strength training. Objective: Study the training strategy of the muscles that make up the elbow joint in table tennis players and its influence on sports. Methods: This paper selected 5 high-level high school table tennis athletes from a university as research volunteers. The training content included strength training, flexibility training, and other physical tests. The duration of the training was one hour, four times a week. The total training lasted six weeks. Results: For the movement at a speed of 180°/s, the peak torque, the relative peak torque, and the percentage of peak flexor and extensor torque of the elbow joint of the athletes showed significant gains. However, the elbow joint change in flexion range was much shorter than in extension. Conclusion: Coaches and athletes should choose a mode of elbow muscle training according to their actual needs, promoting the development of elbow muscle strength in athletes to raise their competitive level. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Physical Education and Training; Racquet Sports; Elbow Joint.

RESUMO

Introdução: O tênis de mesa é amplamente aclamado pelo público e é também uma das atividades populares mais escolhidas pelos atletas chineses. Entretanto, no processo de treinamento esportivo, muitos atletas só prestam atenção ao aprendizado das habilidades esportivas e negligenciam o treinamento da força muscular. Objetivo: Estudar a estratégia de treinamento dos músculos que compõe a articulação do cotovelo em jogadores de tênis de mesa e a sua influência nos esportes. Métodos: Este trabalho selecionou 5 atletas de tênis de mesa de alto nível do segundo grau de uma universidade como voluntários de pesquisa. O conteúdo do treinamento inclui treinamento de força, treinamento de flexibilidade, entre outros testes físicos. A duração do treinamento foi de uma hora, quatro vezes por semana. O treinamento total teve duração de seis semanas. Resultados: Para o movimento com a velocidade de 180°/s, o torque de pico, o torque de pico relativo e a porcentagem de torque de pico do flexor e extensor da articulação do cotovelo dos atletas mostraram ganhos expressivos. Porém o intervalo de alteração articular do cotovelo na flexão foi muito menor do que na extensão. Conclusão: Os treinadores e atletas devem eleger um modo de treinamento muscular do cotovelo de acordo com as suas necessidades reais, promovendo o desenvolvimento da força muscular do cotovelo nos atletas para elevar o seu nível competitivo. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

***Descritores*:** *Educação Física e Treinamento; Esportes com Raquete; Articulação do Cotovelo.*

RESUMEN

Introducción: El tenis de mesa goza de una gran aceptación por parte del público y es también una de las actividades más populares elegidas por los deportistas chinos. Sin embargo, en el proceso de entrenamiento deportivo, muchos atletas sólo prestan atención al aprendizaje de habilidades deportivas y descuidan el entrenamiento de la fuerza muscular. Objetivo: Estudiar la estrategia de entrenamiento de los músculos que componen la articulación del codo en jugadores de tenis de mesa y su influencia en el deporte. Métodos: Este trabajo seleccionó a 5 atletas de tenis de mesa de alto nivel de una universidad como voluntarios para la investigación. El contenido de la formación incluye entrenamiento de fuerza, entrenamiento de flexibilidad, entre otras pruebas físicas. La duración del entrenamiento fue de una hora, cuatro veces por semana. La formación total duró seis semanas. Resultados: Para el movimiento con la velocidad de 180°/s, el par máximo, el par máximo relativo y el porcentaje del par máximo del flexor y del extensor de la articulación del codo de los atletas mostraron ganancias expresivas. Sin embargo, el rango de cambio de la articulación del codo en flexión fue mucho menor que en extensión. Conclusión: Los entrenadores y los atletas deben elegir un modo de entrenamiento de los músculos del codo de acuerdo con sus necesidades reales, promoviendo el desarrollo de la fuerza muscular del codo en los atletas para elevar su nivel competitivo. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

***Descriptores*:** *Educación y Entrenamiento Físico; Deportes de Raqueta; Articulación del Codo.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0512 Article received on 09/20/2022 accepted on 10/21/2022

INTRODUCTION

Table tennis is less restricted by the site conditions, the equipment is simple and easy to carry, and has good operability and appreciation. Therefore, it has a good popularity both on the international stage and in daily public life.[1] Different from the mass table tennis, table tennis players pay more attention to the scientific nature of sports. How to effectively use their own muscle strength to obtain better training results and higher competitive results in the shortest time is the goal that table tennis players and coaches are unremittingly pursuing.[2] To strengthen the muscle movement of the elbow joint and obtain better service efficiency, it is not only necessary to repeatedly practice, but also to master the scientific nature of the movement. At present, there are many researches on muscle strength training, but the specific muscle strength of the elbow joint of table tennis is relatively small, and the research on the elbow joint mostly stays in the aspect of joint muscle injury.[3,4]

In order to more systematically analyze the training strategies of the elbow joint muscles of table tennis players and more scientifically disassemble the muscle movement in the process of hitting, this study takes 5 table tennis players as the research object to explore the changes of the peak torque of elbow joint flexor and elbow joint extensor at different speeds before and after training.[5] To explore the intense activity time of elbow joint related muscles, so as to provide some development strategies for table tennis athletes' elbow joint specific muscle training.[6]

METHOD

In this paper, five high-level table tennis team athletes from sophomores of a university were selected as the research objects. The specific situation is shown in Table 1.

5 athletes ABCDE were trained in elbow muscles, including strength training, flexibility training, flexibility training and so on. The study and all the participants were reviewed and approved by Ethics Committee of Beijing Sport University (NO.20BJSU83-TP). The training duration is one hour, and the training is conducted four times a week. The overall training lasts for six weeks.

Before and after sports training, the peak torque of elbow flexor and elbow extensor were measured at different speeds, and the results were compared. In the measurement of the electromyographic activity time of the muscles related to the elbow joint, the noraxon surface electromyography test and analysis system and high-speed camera were used to accurately control the time during the movement, and the surface electromyography tester was used to measure the muscle groups related to the elbow joint movement, including the long head of biceps brachii, brachioradialis, triceps brachii, anterior part of deltoid, middle part of deltoid, erector spinalis, upper part of trapezius, middle part of trapezius Pectoralis major and the like. The obtained data are summarized and sorted out, and the charts are drawn by Excel software to facilitate subsequent research and analysis.

RESULTS

Changes of peak moment of elbow joint of athletes before and after training

In order to grasp the impact of elbow muscle training on the elbow muscle of table tennis players in a more microscopic way, this paper uses the isomed2000 isokinetic muscle strength test system in Germany to measure the peak torque of elbow flexor and elbow extensor at different speeds before and after sports training. The specific results are shown in Table 2 and table 3.

Table 1. Basic information analysis of subjects.

Subject	A	B	C	D	E
Height (CM)	168.26	166.26	164.63	165.7	162.82
Weight (kg)	48.09	64.45	50.54	47.48	69.52
Training period (year)	14.36	11.63	11.92	14.53	11
Age	20.27	19.11	19.68	19.82	18.74

It can be seen from Table 2 that in terms of the peak torque of the elbow joint flexion, for the movement of 15 °/s, the peak torque is raised from the (49.60 ± 5.469) NM before training to the training (49.84 ± 9.611) NM after training (49.84 ± 9.611) NM ; The relative peak torque is raised from (0.64 ± 0.118) nm/kg before training to trained (0.66 ± 0.121) nm/kg; the peak torque percentage is increased from (92.90 ± 4.788)%before training to the training (93.01111 ± 2.532)%. For actions with a speed of 90 °/s, the peak torque was raised from the (43.90 ± 5.160) nm before training to the trained (46.08 ± 9.000) nm; the relative peak torque was before the training (0.57 ± 0.109) nm/ KG was upgraded to the training (0.62 ± 0.108) NM/KG after training; the percentage of the peak torque was increased from (84.65 ± 6.089)%before the training (85.37 ± 3.158)%. For the movement of 180 °/s, the peak torque was raised from the (40.05 ± 5.463) nm before training to the trained (41.38 ± 7.895) nm; the relative peak torque was before the training (0.51 ± 0.112) nm/ KG was upgraded to the training (0.57 ± 0.078) NM/KG after training; the percentage of the peak torque was increased from (77.27 ± 6.374)%from the trained (75.18 ± 7.798)%before training. By classifying the three speed indicators of 15 °/s, 90 °/s, 180 °/s in the process of flexor muscle, it can be seen from the vertical contrast. As the speed of the elbow muscle movement increases, the peak torque before and after training, relative to relative the increase in the three indicators of peak torque and peak torque ratio has increased, and in most cases, as the speed of exercise increases, the increase in related indicators has gradually increased. From the horizontal contrast, it can be seen that during the same period, the three indicators of peak torque, relative peak torque, and peak torque were determined. As the speed increased, the values of the three indicators gradually decreased. It can be seen that the training of elbow muscle strength training can effectively enhance the development of the athlete's elbow flexion muscle strength. Relatively speaking, the faster the speed, the more obvious the effect.

Table 2. Changes of peak moment of elbow flexor at different speeds before and after training.

Time	Index classification	15°/s	90°/s	180°/s
Before training	Peak torque (Nm)	49.60±5.469	43.90±5.160	40.05±5.463
	Relative peak torque (NM/KG)	0.64±0.118	0.57±0.109	0.51±0.112
	Peak torque percentage (%)	92.90±4.788	84.65±6.089	75.18±7.798
After training	Peak torque (Nm)	49.84±9.611	46.08±9.000	41.38±7.895
	Relative peak torque (NM/KG)	0.66±0.121	0.62±0.108	0.57±0.078
	Peak torque percentage (%)	93.01±2.532	85.37±3.158	77.27±6.374

Table 3. Training before and after athletes at different speeds of elbow joint extensor peak torque changing.

Time	Index classification	15°/s	90°/s	180°/s
Before training	Peak torque (Nm)	48.30±6.785	42.85±4.654	37.66±4.654
	Relative peak torque (Nn/kg)	0.63±0.148	0.56±0.118	0.48±0.112
	Peak torque percentage (%)	90.15±5.399	82.51±4.492	70.49±5.975
After training	Peak torque (Nm)	58.22±10.724	54.89±11.250	47.35±9.869
	Relative peak torque (Nn/kg)	0.77±0.121	0.72±0.117	0.66±0.029
	Peak torque percentage (%)	95.86±2.532	87.51±5.230	75.99±7.992

It can be seen from Table 3 that in terms of the peak torque of the elbow joints, the peak torque is raised from the (48.30 ± 6.785) nm before training to 58.22 ± 10.724) nm; The relative peak torque was increased from (0.63 ± 0.148) nm/kg before training to trained (0.77 ± 0.121) nm/kg; the peak torque percentage was increased from (90.15 ± 5.399)%before training to the training (95.86 ± ± ± 2.532)%. For actions with a speed of 90 °/s, the peak torque was raised from the (42.85 ± 4.654) nm before training to the trained (54.89 ± 11.250) nm; the relative peak torque was before the training (0.56 ± 0.118) nm/ KG was upgraded to the training (0.72 ± 0.117) NM/KG after training; the percentage of the peak torque was increased from (87.51 ± 5.230)%of the trained (82.51 ± 4.492)%before training. For the movement of 180 °/s, the peak torque was raised from the (37.66 ± 4.654) nm before training to the training (47.35 ± 9.869) nm after training; the relative peak torque was before training (0.48 ± 0.112) nm/ KG was upgraded to the training (0.66 ± 0.029) NM/ KG after training; the peak torque percentage was increased from the trained (70.49 ± 5.975)%before the training (75.99 ± 7.992)%. It can be seen through vertical comparison that after 6 weeks of elbow muscle strength training, the athletes have peak torque, relative peak torque, peak torque percentage such as 15 °/s, 90 °/s, and 180 °/s. Both have improved. Although the increase between the three still shows a trend of increased with the speed, the gap between each other is small, and the increase is much higher than the related indicators of elbow joint flexion. It can be seen from the horizontal contrast between the group that with the improvement of the speed of exercise, the peak torque, relative peak torque, and peak torque percentage all show a decline.

The impact of elbow muscle training on the process of exercise

In order to study the impact of elbow muscle training on the movement process, this article collects the muscle and electricity activity time during the continuous changes after the start of the ball, as shown in Figure 1, 2, and 3.

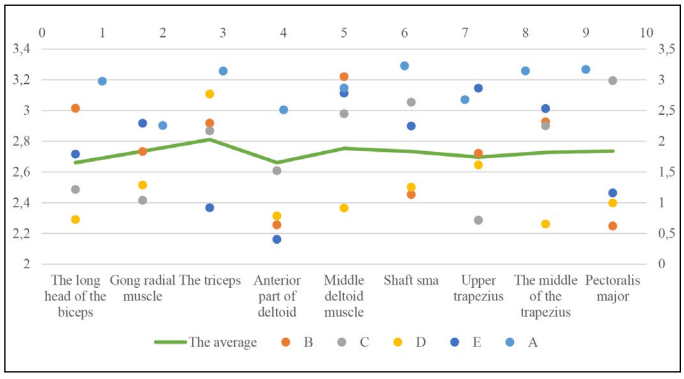

Figure 1. Myoelectric activity time of elbow joint related muscles during the start of hitting.

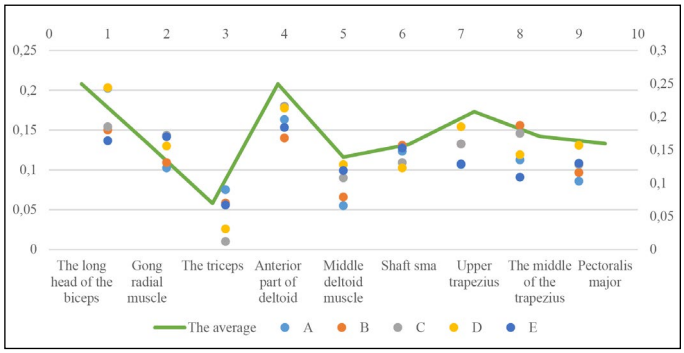

Figure 2. Electromyographic activity time of elbow joint related muscles during. continuous stroke.

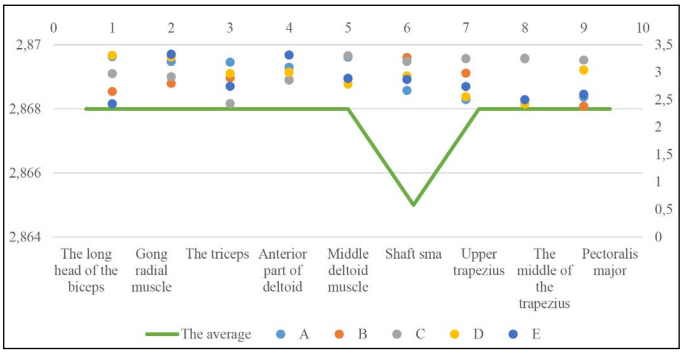

Figure 3. Electromyographic activity time of elbow joint related muscles in the end of hitting.

As shown in Figure 1, at the beginning of the exercise, the central nervous system of the athlete's brain issues and judges the instructions, and completes the start of relevant actions through the activation of muscles.

As shown in Figure 2, in the continuous stage of the movement, different muscle forces are connected. The core strength of the waist and legs is used to complete the control of the hitting action and direction. The arm is used to store energy in advance and provide power transmission.

As shown in Figure 3, during the ending process, each muscle of the athlete's body gradually ends its movement, and its discharge action presents a relatively gentle trend as a whole.

From the comprehensive analysis of Figure 1, Figure 2 and Figure 3, it can be seen that the relevant muscles of the elbow joint show multiple stages such as receiving instructions, starting to send force and ending the movement. In this process, the force provided by the muscle movement is related to the current. The force release of the muscle group can be analyzed by measuring the electromyographic parameters. And good EMG activity time can improve the coordination of athletes' movement and make them better control the development of their own muscle strength.

DISCUSSION

By sorting and analyzing the electromyographic activity characteristics and peak torque characteristics of elbow muscles in the process of table tennis, it can be seen that the muscle strength of table tennis players in the elbow extension movement is lower than that in the elbow flexion movement, which indicates that the main power of the athletes is obtained when they bend their elbows. In the process of elbow flexion, biceps brachii shows obvious spike like electromyographic characteristics. Through the morphological characteristics of sharp ends and gentle middle, the effect of rapid start and termination of muscles can be achieved. Through rapid discharge, great explosive force can be brought to the upper limb muscles of athletes, which is convenient for the use of muscle strength during the hitting process. In the process of elbow extension, the muscle that mainly provides strength is triceps brachii. The electrical activity characteristics of triceps brachii are opposite to that of biceps brachii. Its electromyographic characteristics are gentle at both ends and sharp in the middle. Although the principles of the two are somewhat similar, on the whole, the explosive electrical activity of biceps brachii is far more than the explosive electrical activity of triceps brachii, which is shown in the macro view that the muscle strength during elbow extension is lower than that during elbow flexion.

CONCLUSION

Through the study of this paper, we can see that the current table tennis players have different sports training focuses, and the training of elbow muscle strength is not comprehensive. For different muscle

groups, some muscle groups have better development space. Therefore, coaches and athletes should, according to their own actual needs, choose the elbow muscle training mode suitable for their special skills, promote the development of the elbow muscle strength of athletes, improve their hitting efficiency and hitting skills, enhance the coordination of the body, and promote the improvement of their competitive skills.

The author declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: The author has completed the writing of the article or the critical review of its knowledge content. This paper can be used as the final draft of the manuscript. Every author has made an important contribution to this manuscript. Danyang Liu: writing and execution.

REFERENCES

1. Zhang Jun. Influence of progressive upper limb strength training on table tennis athletes. RBME. 2022;28(6):734-7.
2. Wang W, Li Y. Study on treatment and rehabilitation training of ligament injury of javelin throwers based on sports biomechanics. Measurement. 2021;171(4):108757.
3. Quartey J, Afidemenyo S, Kwakye SK. Athletes' expectations about physiotherapy in sports injury rehabilitation in greater Accra region. Hong Kong Physiother J. 2019;39(2):1-14.
4. Cho KH, Song WK. Effect of robot arm reach training on upper extremity functional movement in chronic stroke survivors: a preliminary study. Phys Ther Rehabil Sci. 2019;8(2):93-8.
5. Liu J, Wan L. Application value of different dimension ZnO nano materials in sports rehabilitation of basketball players with limb fracture injury. Ferroelectrics. 2021;579(1):133-47.
6. Jones A, Hind K, Jones G, Wilson HV, Francis P. 312 Skeletal muscle contractile properties before, during and after muscle injury in male professional football players. Br J Sports Med. 2020;54(Suppl 1):A128.