

Effect of TRX Suspension Training on Dorsal Muscle Strength and Isometric Muscle Endurance of Police College Students

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Abstract—The purpose of this study was to investigate the effects of 12-week TRX suspension training and instrument resistance training on dorsal muscle strength and isometric muscle endurance of police college students. Thirty male students from Nanjing Forest Police College were randomly divided into TRX suspension training group (TRX group) and ART training group (ART group). Each group received a 90-minute training course twice a week for 12 weeks. The dorsal muscle strength and isometric muscle endurance of all subjects were tested before and after training. After statistical analysis of T test of dependent samples, it was found that the dorsal muscle strength in TRX suspension training group was significantly improved and the dorsal muscle strength in instrument resistance training group was also significantly improved. This study believes that TRX training can effectively train muscles in the dorsal muscle, which is a beneficial attempt and an effective supplement to the traditional physical training methods.

Keywords—Police college; TRX; Dorsal strength; Isometric muscle endurance

I. INTRODUCTION

TRX is a unique, convenient, effective and portable suspension training system. It can be a beneficial attempt and an effective supplement to the traditional physical training methods of police college if the new TRX suspension training methods in current physical training can be introduced to effectively train the core muscle (the basis for efficient execution of police technical and tactical abilities) and explosive forces by hanging the fixed points with one hand, two hands, one foot or two feet and simultaneously involving the sagittal plane, frontal plane and horizontal plane of the body, to promote proprioception control as well as exercise ability control, and increase core stability, muscle strength, endurance and cardiovascular function. TRX has changed a lot in recent years, such as the concept of field training designed by the US Navy SEAL Team, which can be used in a convenient, effective, portable and suitable training mode for various physical abilities in a combat environment lacking resources. Using TRX as a single part of muscle training can link the core surface muscle group and core stable muscle group of human body, increase joint stability, strengthen ligaments, enhance core muscle group as well as explosive force and increase sports performance, so it can theoretically be

popularized to police's professional physical training. In order to verify the difference between TRX training and traditional apparatus resistance training in physical quality, this study takes TRX training and apparatus resistance training as variables to observe the influence and difference of the two training methods on the dorsal muscle strength and isometric muscle endurance of police college students, with a view to providing scientific reference for the reform of teaching content of police physical ability courses in public security colleges.

II. RESEARCH OBJECTS AND METHODS

A. Research Objects

Thirty male college students from Nanjing Forest Police College were subjects, with an average age of 19.4 ± 1.3 yrs., an average height of 173.5 ± 3.4 cm and an average weight of 68.7 ± 3.9 kg. They were randomly divided into the experimental group of 15 and the control group of 15. The experimental group was given TRX suspension training, while the control group was given apparatus resistance training.

B. Research Methods

1) Experimental Control:

a) It is confirmed that all subjects have no cardiovascular diseases, hypertension and related visceral diseases, and can accept the maximum exercise test;

b) Subjects are not allowed to take part in any strenuous exercise or drink drinks containing caffeine, creatine, branched-chain amino acids and alcohol within 24 hours before the experiment and are required to sleep for at least 6 hours;

c) The subjects should not have any history of upper limb muscle and joint injuries in the past six months in order to avoid experimental deviation;

d) The subjects are not allowed to be engaged in strenuous exercise and produce muscle injury or soreness before the measurement on the week and day of the experiment;

e) Each measurement time is controlled in the same time period to avoid interfering variables;

f) The average height and weight of the subjects are controlled within 5 to avoid experimental errors caused by additional factors;

g) On the day of the experiment, all the subjects do not have any ongoing diseases, such as cold, fever, etc.

h) It is ensured that the subjects understand the purpose, process and rights of this experiment and complete the experiment indoors.

2) *Experimental Design:*

a) *Experimental Process*

According to the purpose of this study, all subjects were randomly divided into TRX suspension training (TRX) and apparatus apparatus resistance training (ART) for 12 weeks, twice a week for 90 minutes. The experimental process is divided into three stages:

- Pret-test of dorsal muscle strength, dorsal muscle isometric endurance.
- 12-week TRX suspension training and apparatus resistance training.
- Post-test of dorsal muscle strength, dorsal muscle isometric endurance.

b) *Training Course*

Training course divides the 90-minute course into 3 parts:

- Warm-up exercise. It lasts 15 minutes. It takes low-intensity aerobic exercise to raise the body's working temperature, improve muscle elasticity and extensibility through dynamic stretching, increase the range of joint movement and connecting sensory and motor neurons as the main training courses and avoid sports injuries [1,2].
- Main courses (TRX suspension training and equipment apparatus resistance training). It lasts 60 minutes. In this study, 10 muscle parts of the large muscle group of the body are used as the main training parts for TRX suspension training and equipment apparatus resistance training, including dorsal muscle, latissimus dorsi, erector spinae. Table 1 shows the principles of TRX suspension training and apparatus resistance training.
- Relaxation exercise. It lasts 15 minutes. It takes the initiative to recover with low-intensity aerobic or stretching movements, accelerate the discharge of metabolic wastes in the body after training, relieve the tight muscle parts after training, reduce the accumulation of lactic acid and stretch the muscles of each training part, and reduce the muscle soreness and fatigue after exercise.

TABLE I. PRINCIPLES OF TRAINING

Parameter	Training type	
	TRX Suspension Training	Resistance Training
Preset	Before the start of the course, the subjects are arranged to experience the course description and actual operation, and measure the maximum muscle strength (1RM) so that the 12 - week training can proceed smoothly.	
Times of Repetition	According to the suggestion of ACSM (2011) of the American Sports Medical Association, the recommended number of repetitions for improving muscle fitness is 8-12 times. Therefore, this study adopts ACSM's suggestion and sets the times of repetitions for each group to 8 - 12 times.	
Repeated Group	In the first 6 weeks, the number of repeated groups for each muscle part was 2 groups, and in the last 6 weeks, the muscle fitness of TRX suspension training group and equipment resistance training group was increased to 3 groups.	
Load	Adjust the load intensity by angle, based on the number of repetitions of 8 ~ 12.	Based on the maximum muscle strength (1RM) of 70% ~ 80%, the number of repetitions should be 8 ~ 12.

3) *Training Method:*

a) *Dorsal muscle Training*

TRX group: The subjects repeat 8~12RM times to adjust the load, with the body facing the anchor point (TRX binding position), with shoulder horizontal abduction and back muscle contraction as the main movements, using the body weight as the load, the lighter the weight of the body perpendicular to the floor, the heavier the weight of the body parallel to the floor.

ART group: The main movements are horizontal abduction of shoulder joint and contraction of dorsal muscle, and the number of bars is adjusted by 8 ~ 12rm to determine the weight load, as shown in Table 2.

TABLE II. DORSAL MUSCLE TRAINING

Type	Weight	
	Low	High
TRX		
ART		

b) *Erector Spinae Training*

TRX group: The subjects repeat 8 ~ 12RM times to adjust the load, with the body prone under the anchor point (TRX binding position), with spine stretching and erector spinae contraction as the main movements, with both hands in a capitulation position, with the weight lighter as the body gets closer to the anchor point [3-4]. The farther they stretch their body from the anchor point, the heavier their weight will be.

ART group: With spine stretching and erector spinae contraction as the main movements, the weight of hand-held dumbbells is adjusted 8 ~ 12RM to determine the weight, as shown in Table 3.

TABLE III. ERECTOR SPINAE TRAINING

Type	Weight	
	Low	High
TRX		
ART		

c) Latissimus Dorsi Training

TRX group: The subjects adjust the weight with 8 ~ 12RM repetitions, with the body directly under the anchor point (TRX binding and hanging position), with the adduction of the shoulder joint and the contraction of the latissimus dorsi as the main actions, using the feet to support the weight with the help of the ground, the lighter the weight the feet bear with the force, the heavier the weight the feet bear off the ground [5,6].

ART group: With shoulder adduction and latissimus dorsi contraction as the main movements, the number of bars is adjusted by 8 ~ 12rm to determine the weight load, as shown in Table 4.

TABLE IV. LATISSIMUS DORSI TRAINING

Type	Weight	
	Low	High
TRX		
ART		

4) *Experimental Indicators:*

a) Strength of dorsal muscle

Equipment: stable table top, stopwatch, fixed belt and hand-held electronic myometer.

Steps:

- Subject lies prone on a stable table top with the upper body supported on a lower table top, with the anterior superior iliac spine as the boundary.

- The upper part of the upper body above the anterior superior iliac spine is on the lower table top, and the lower part below the anterior superior iliac spine is on the higher table top.
- Subject fixes the pelvic position and ankle position of the subject with a fixing rope on a higher table top so as to fix the lower body of the subject.
- When hearing the start password, the subject put his hands behind his head and raised his body above the table top, leaving his upper body away from the lower table top.
- At this time, the researchers placed the hand-held electronic muscle strength tester at the intersection of the left and right lower scapula angles with the spine (about the seventh segment of the thoracic spine).
- The subject is given the maximum resistance they can bear and measure their maximum strength of the dorsal muscles until their bodies are lower than the tabletop, a total of three tests.

b) Isometric endurance of Dorsal Isolongus

Equipment: stable table top, stopwatch and fixing belt.

Steps:

- The subject lies prone on a stable table top with the upper body supported on a lower table top, with the anterior superior iliac spine as the boundary.
- The upper part of the upper body above the anterior superior iliac spine is on the lower table top, and the lower part below the anterior superior iliac spine is on the higher table top.
- The subject fixes the pelvic position and ankle position of the subject with a fixing rope on a higher table top so as to fix the lower body of the subject.
- When hearing the start password, the subject put his hands behind his head and raises his body above the level of the table top, leaving the upper body away from the lower table top.
- Researchers stop timing when the subject's upper body is lower than the desktop, and record the time when the subject maintains this posture with a stopwatch.

5) *Statistical Processing and Analysis:*

SPSS 19.0 was used for statistical processing, and the results were expressed by means standard deviation ($\bar{X} \pm SD$). The basic data of TRX suspension training group and instrument apparatus resistance training group were analyzed by independent sample T test. The influence of TRX suspension training group and instrument apparatus resistance training group on core muscle group and explosive force was compared by paired sample T test. Statistically the significant level was $P < 0.05$ and the extremely significant level was for $P < 0.01$.

III. RESULTS AND ANALYSIS

A. *Difference in the Effect of TRX Suspension Training and Apparatus Resistance Training on the Strength of the Dorsal Muscles*

The anterior test average of the back muscle strength of TRX suspension training group was 74.14 ± 13.97 before the exercise intervention, the posterior measurement was 99.14 ± 14.72 after the exercise intervention, the anterior measured mean of the muscle force of the back muscle of the apparatus apparatus resistance training group was 69.50 ± 15.71 before the exercise intervention, and the posterior measurement after the exercise was 87.43 ± 13.56 , the results showed that the two groups had significant progress on the muscle strength of the dorsal muscle after the exercise intervention after the exercise involvement in the training group of TRX suspension training group and the anti-apparatus resistance training team of the device ($P < 0.05$). Table 5 shows the difference of the effect between TRX Suspension Training and apparatus resistance training on dorsal muscle strength.

TABLE V. COMPARISON OF DORSAL MUSCLES STRENGTH

<i>Test</i>	<i>group</i>	<i>Pre-test</i>	<i>Post-test</i>	<i>P</i>
dorsal muscles strength	TRX	74.14 ± 13.97	99.14 ± 14.72	0.001**
	ART	69.50 ± 15.71	87.43 ± 13.56	0.003**

* $P < 0.05$

B. *Difference in the Effect of TRX Suspension Training and Apparatus Resistance Training on the Isometric Endurance of the Dorsal Muscles*

The anterior test average of the dorsal muscle endurance of TRX suspension training group was 68.59 ± 36.07 before the exercise intervention. After the exercise intervention was 84.03 ± 26.94 , and the long muscle endurance part of the back muscle of the apparatus apparatus resistance training group was 60.50 ± 16.97 before the exercise intervention. After exercise intervention, the posterior test was 68.74 ± 19.79 , and the results showed that the training group of TRX suspension training group and the apparatus resistance training team of the apparatus were different before and after the exercise intervention, it was found that the two groups had no significant progress in the muscular endurance of the dorsal muscles after the exercise intervention ($P > 0.05$). Table 6 shows the difference of the effect between TRX Suspension Training and apparatus resistance training on abdominal muscle strength. difference of isometric endurance training effect of TRX suspension training and apparatus resistance training for dorsal muscles.

TABLE VI. COMPARISON OF ABDOMINAL DORSAL MUSCLE ENDURANCE

<i>Test</i>	<i>group</i>	<i>Pre-test</i>	<i>Post-test</i>	<i>P</i>
Isometric muscle endurance	TRX	68.59 ± 36.07	84.03 ± 26.94	0.058
	ART	60.50 ± 16.97	68.74 ± 19.79	0.106

** $P < 0.01$

IV. CONCLUSION

The results showed that the apparatus resistance training of the apparatus was not significantly improved after 12 weeks of systemic muscle training, and there was no significant improvement in the isometric endurance of the dorsal muscles, and the apparatus resistance training was not effective for the deep core stable muscle group. TRX suspension training is a significant improvement in the duration of the muscle endurance of the abdominal muscles after 12 weeks of systemic muscular training Also represents TRX suspension training for Deep core stable muscle group has obvious effect exists.

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