

LETTER TO THE EDITOR

Surface Electromyography of Quadriceps in Athletes with Patellar Tendinopathy during Isokinetic Exercise based on Ecological Environment

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To Surface electromyography of quadriceps in athletes with patellar tendinopathy during isokinetic exercise based on Ecological Environment, and to analyze the relationship between patellar tendinopathy and vastus medialis obliquus/ vastus lateralis muscle balance.

Eighty athletes with patellar tendinopathy were selected as the study group patients in this study. Eighty healthy athletes were selected as the reference group. The time range was from May 2016 to October 2018. Compared with the healthy athletes in the reference group, the athletes with patellar tendinopathy in the study group had a larger VMO: VL ratio, $p < 0.05$, statistically significant. In comparison of VMO and VL excitation time between the two groups, no significant difference was shown between the two groups, $p > 0.05$, not statistically significant. The athletes with patellar tendinopathy showed VMO/VL imbalance. It is necessary to scientifically select rehabilitation training measures to prevent and control athletes' patellar tendinopathy.

I Introduction

Mingquan Long published "Key Factors of Students' Participating in Ecology Sports Motivation" on Issue 107, Pages: 1599-1603, Article No: e107185, Year: 2019, in the article, With the progress of medical treatment in modern society, the average life of human beings has been continuously prolonged, and the public's demand for quality of life and health has increased a lot. Proper sports activities cannot only relax the pressure of daily life, but also improve the quality of life. China's basic priority for educational goals is to develop the healthy physique of citizens. School physical education is one of the components of education, is an important method to develop students' complete development, and is to improve the national physical fitness level. The foundation for the development of national sports is also the cradle for the exploration and training of outstanding sports talents. In this study, Hunan primary school students were taken as the subjects of questionnaire analysis. 500 samples were distributed and 371 valid questionnaires were recovered, with a recovery rate of 74%. The results of the study are as follows: In the second level of evaluation, the most important dimension is "physiology". The second are "psychology" and "social". Among the 14 evaluation indexes, the top five indexes that are paid most attention to are: sports technology, ability performance, sports knowledge, friendship and physical health. According to the results, suggestions are put forward in the hope that students participating in sports can increase and continue their

love of sports, and gain physical health, spiritual satisfaction and good habits of lifelong sports in the process of participating in sports.

Patellar tendinopathy, also known as patellar tendon disorder, jump knee or patellar tendonitis, is the most common occupational disease among athletes, which is a general term for a series of pathological changes in which terminal region of quadriceps tendon stop point is subjected to chronic repeated traction, leading to damage of bone-tendon binding site structure (Wang et al. 2016). It's simple symptom is great pain in bone below the knee during jump and movement, which will be aggravated after the exercise ends (Hua et al. 2017). At present, with the increase in the number of professional athletes, incidence of such injuries is also on the rise. The causing factors include that athletes fail to do special exercises for lower limb strength, have bad postures during jumping and landing, or rarely perform traction relaxation after the exercise (Chen et al. 2017). Under normal circumstances, the patient will have iliotibial tract tension problem in the lateral thigh, accompanied by imbalance of the muscles in the front and back of the thigh.

II Data and Methods

The study targeted at 160 athletes, 80 of whom had patellar tendinopathy (study group) and 80 were healthy athletes (reference group). The time range was from May 2016 to October 2018. The imaging picture of 1 patient is shown in Figure1 below. There were 50 male athletes and 30 female athletes in the study group, aged between 18 and 28 (22.4 ± 0.9) years old, with 25, 30, 25 cases of martial arts athletes, volleyball players and basketball players, respectively. There were 48 male athletes and 32 female athletes in the reference group, aged between 18 and 30 (23.5 ± 0.6) years old, with 14, 26, 40 cases of martial arts athletes, volleyball players and basketball players, respectively. Comparison of the data of the two groups shows comparability, $p > 0.05$. All subjects maintained normal training state, receiving no local blockage or knee joint surgery within half a year. Patients and their families had the right to know and signed the informed consent form, and the study was implemented with the approval of the Hospital Ethics Association.

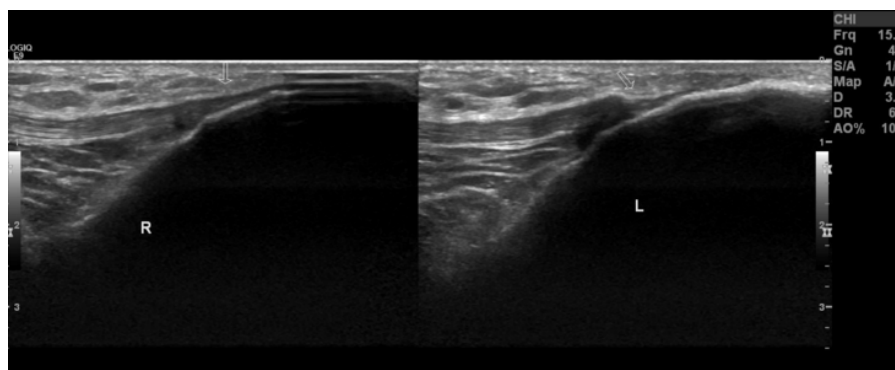


Fig 1. 1 patient's imaging examination chart

The athletes in the study group had the painful knee joint tested and the matched athletes were tested in the ipsilateral knee joint. The test items involved included Q angle measurement, quadriceps centrality and maximum centrifugal active contraction. Muscle testing was performed on BIODEX 3 isokinetic tester. The athletes kept a sitting state with torso and thighs fixed. Centripetal and centrifugal exercises were first performed with good preparation activities done. Then, active contraction movement of the quadriceps was carried out, mainly including: five centripetal movement at $60^\circ/s$ and five centrifugal movement at $60^\circ/s$, with 1 minute interval between the two.

During centripetal exercise, 90° knee flexion was taken as the preparation posture, with range of motion between 90° knee flexion and 0° knee flexion. For centrifugal exercise, 10° knee flexion was performed as preparation posture, with range of motion between 90° knee flexion and 10° knee flexion.

Surface electromyography information was tested using an 8-lead Noraxon 1600 surface electromyograph. The skin around the tested knee joint was shaved and sterilized strictly. The bipolar Ag/AgCl disc electrode for surface electromyography was placed on the surface of VMO and VL in the direction of the muscle fibers. The obtained surface electromyography data was processed by Myoresearch XP1.03.06 (Wang and Yue 2017). After full-wave filtration, RMS (100 ms window) softening and average amplitude standardization, the integrated electromyography (IEMG) and excitation time were counted to obtain ratio of integrated electromyography (VMO:VL) and difference in excitation time between the two.

The statistical analysis software used was SPSS21.0. Where, the measurement data was expressed by mean \pm average number ($\pm s$), t was used for comparison between groups; count data was expressed by natural number (n) and percentage (%), and chi-square was taken for comparison between groups. When $p < 0.05$, there is statistical value.

III Results

According to the statistics in Table 1 below, in the centripetal movement, the study group has significantly higher VMO:VL ratio than the reference group, $p < 0.05$, statistically significant; in the centrifugal movement, the study group also has significantly higher VMO:VL ratio than the reference group, $p < 0.05$, statistically significant.

Table 1. Comparison of VMO:VL ratios between the two groups ($\bar{x} \pm s$)

Group	Number of cases	Centripetal movement	Centrifugal movement
Study group	80	1.538 \pm 0.268	1.589 \pm 0.421
Reference group	80	0.835 \pm 0.369	0.796 \pm 0.216
T		5.609	7.312
P		<0.05	<0.05

Comparison of VMO and VL excitation time differences between the two groups

As shown in the statistics in Table 2 below, the differences in VMO and VL excitation time are observed between the two groups. The results show significant differences in both centripetal and centrifugal movement between the diseased study group and the healthy reference group, $p > 0.05$, not statistically significant.

Table 2. Comparison of differences in VMO and VL excitation time between the two groups ($\bar{x} \pm s$)

Group	Number of cases	Centripetal movement	Centrifugal movement
Study group	80	0.069 \pm 0.148	0.279 \pm 1.425
Reference group	80	0.025 \pm 0.126	0.003 \pm 0.048
T		0.713	0.256
P		>0.05	>0.05

IV Discussion

The stress formed by the quadriceps contraction can be transmitted through the tibia, and then patellar tendon

stop device functions as a buffer (Jiang et al. 2016). Although the occurrence mechanism of patellar tendinopathy is yet not clear, repeated jumps during athlete training can cause excessive impact or traction at the tendon end, forming a local blood circulation disorder in the patellar tendon stop device, and eventually leading to patellar tendinopathy (Acar Tek et al. 2017). All subjects in this study maintained normal training status, receiving no local blockage or knee joint surgery within half a year. Meanwhile, epidemiological investigations (Wu et al. 2016) show differences in pathogenesis between patellar tendinopathy in single knee and in both knees. Hence, only athletes with single-knee patellar tendinopathy were enrolled in this study to prevent the impact on experimental results.

Studies have shown that abnormalities in the muscle strength and excitation sequence of VMO and VL can cause an imbalance between the two, which exerts a certain impact on motion trajectory of patella, and at the same time triggers dysfunction of knee extension device. Therefore, the balance between VMO and VL is a key factor to ensure the maintenance of normal function of quadriceps (Guo et al. 2015). It is scientifically feasible to use surface electromyography to evaluate the function of VMO and VL. Surface electromyography (sEMG), also known as dynamic electromyography, uses an electrode placed on the skin surface to record the current formed during muscle contraction. Meanwhile, EMG signal is obtained through the relevant technical processing links for data analysis to obtain the muscle function status. In addition, isokinetic dynamometer can acquire muscle strength test result of the knee joint at a predetermined speed, with reliable credibility and ideal repeatability.

This experiment was designed to obtain sEMG signals of VMO and VL during isokinetic test. The commonly used isokinetic test speed is 60° and 90° per second. The factor of performing the surface electromyography test during isokinetic movement at 60° per second is the consideration that too high speed can easily cause pain in patients with patellar tendinopathy, and also, it enables observation of muscle function under active contraction. The ratio of VMO:VL can effectively measure the balance of muscle strength between VMO and VL. IEMG and muscle strength have a linear proportional relationship that can reflect general activity of the entire muscle. The difference between VMO and VL excitation time represents another important indicator of the balance status between muscles, which can help determine which part of the muscle is stimulated by the central nervous system earlier. The results of this study showed that the athletes with patellar tendinopathy in the study group had a larger VMO: VL ratio compared with the healthy athletes in the reference group, $p < 0.05$, statistically significant. Comparison of VMO and VL excitation time between the two groups revealed no significant difference, $p > 0.05$, not statistically significant. This indicates unbalanced VMO/VL in patients with patellar tendinopathy.

V Conclusion

In summary, this study makes a close observation and analysis of the relationship between patellar tendinopathy and VMO/VL balance. The results show that patellar tendinopathy patients have a relatively enhanced VMO function regardless of centrifugal or centripetal quadriceps contraction movement, but no abnormal excitation sequence is shown. It thus sufficiently demonstrates unbalanced VMO/VL muscle strength in patellar tendinopathy patients. Isokinetic muscle strength test has great application significance in joint muscle strength test and diagnosis and evaluation of exercise injury lesions. Quadriceps constitutes the main structure of the knee extension device. Its muscle balance has a significant influence on contact stress and distribution of patellofemoral joint as well as motion trajectory of patella, which can provide important guidance for clinical research. In addition, the results of this study can, on the one hand, explain the phenomenon of contraction activity imbalance between VM and VL in patellar tendinopathy from electrophysiological aspect of muscles and on the other hand, provide important basis for scientific choice of methods for prevention and rehabilitation training of patellar tendinopathy in athletes.

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