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LETTER TO THE EDITOR

Efficacy Evaluation of Foulage in the Treatment of Tibialis Anterior Athletic Fatigue in Gymnast with Surface Electromyography and Isokinetic Testing based on Ecological Science Theory

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To observe and evaluate the therapeutic efficacy of foulage in the treatment of tibialis anterior athletic fatigue in gymnast with surface electromyography and isokinetic testing. Methods: A total of 140 gymnasts suffered from tibialis anterior athletic fatigue were enrolled. All patients were randomized into research group (foulage group) and control group (rest group), with 70 cases in each group. Tibialis anterior athletic fatigue was modeled with isokinetic testing, once before therapy and once after treatment. In the passive movement of the ankle, the angular velocity was set as 60°/s. Meanwhile, various indexes were measured with surface electromyography during passive movement, including the integrated electromyography, maximal amplitude, median frequency and slope of the tibialis anterior and gastrocnemius muscle. Results: The integrated electromyography, maximal amplitude, median frequency and slope of the tibialis anterior before treatment were recorded during isokinetic testing. And results showed that there was no significant difference between both groups ($P > 0.05$). After 5 minutes of resting, the integrated electromyography and gain ratio, maximal amplitude and gain ratio, median frequency and gain ratio, as well as slope and gain ratio of the tibialis anterior were greatly reduced ($P < 0.05$).When foulage therapy was performed, the above indexes (the integrated electromyography and gain ratio, maximal amplitude and gain ratio, median frequency and gain ratio, as well as slope and gain ratio) of the research group were up-regulated markedly than those of the control group ($P < 0.05$). Conclusion: Application of foulage therapy significantly relieved muscle fatigue. Meanwhile, surface electromyography and isokinetic testing had high scientificity and rationality in evaluating the therapeutic efficacy of foulage in the treatment of tibialis anterior athletic fatigue in gymnast.

I Introduction

Peng-Tao Ma. Buslaev published “The Way and Environment of Physical Training of Canadian Athletes and Inspiration” on Issue: 107, Pages: 4249-4256, Article No: e107474, Year: 2019, in the article, we are often and times met with the popular ideas on the education and development of good athletes which have concluded that athletic excellence as primarily the result of innate abilities or extensive practice and experience. However, greater

emphases on innate abilities identification and development early in childhood will increase the possibility of suboptimal outcomes from both participation in sport generally, and innate abilities identification and development in particular. In this paper, we describe a framework for understanding how biases in athlete development emerge between advantaged and disadvantaged youth. Specifically, we propose conceptualizing biases using the theory of Life Cycle Skill Formation and review three significant biases on athlete development: relative age, birthplace effects and socioeconomic status, all of which are specific to the developmental environment of high performance sport. We conclude with a discussion on the processes that perpetuate bias in high performance sport and suggest several directions for future research in this area.

II Data and Methods

A total of 140 gymnasts suffered from tibialis anterior athletic fatigue (as shown in Figure 1) and treated at our hospital from January 2015 to August 2018 were enrolled. All patients enjoyed the right to know, and formal consent forms were obtained. This study was approved by the ethic committee of our hospital. The patients were randomized into research group (foulage group) and control group (rest group), with 70 patients in each group. Of those, there were 40 male patients and 30 female patients in the control group, with an average age of（27.9±3.1）years, ranging from 20 to 30. Moreover, there were 44 male patients and 26 female patients in the control group, with an average age of（28.6±3.9）years, ranging from 22 to 32. Data obtained from both groups was comparable ($P > 0.05$).

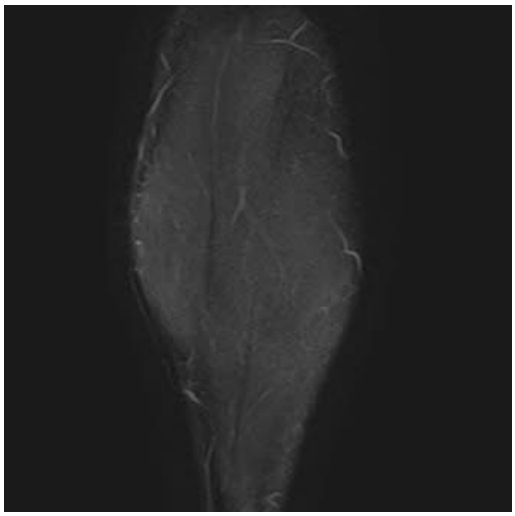

Fig 1. The abnormal signals around the tired tibialis anterior

Biodex System-3 multi-joint isokinetic muscle tester was applied on the left lower extremity to prepare tibialis anterior muscle fatigue model. First, the patients were introduced to the basic methods and essentials for the isokinetic muscle strength test. Three sub-level ankle joint flexion and extension exercise were performed as preparation activities before the test. Secondly, the patient's file was built. After inputting the patient’s name and other information into the training system, scientific test program was selected, that is, the constant speed of the movement was set to 60°/s, with 5 minutes of interval. Next, we immobilized the patient. The patient’s left ankle is fixed on the power shaft of the isokinetic tester, the torso and the left thigh are fixed onto the test chair, and the left ankle joint is bundled on the head of the force measuring arm (Attari et al. 2016, Xie et al. 2016). Finally, the test was started. The ankle joint activity was set and the left lower limb was weighed. Click on the start button, and

the patient was told to dorsal stretch the power arm. Under maximal joint mobility, flexes the joint to its original position. The ankle was repeatedly flexed and extended for 50 times in this way. In addition, the isokinetic muscle strength evaluation IN training system was adopted to collect and record the muscle contraction mechanical signals during exercise, constructing tibialis anterior muscle fatigue model (Wang et al. 2018). At all stages of the test, the EMG signal was measured on the anterior tibial muscle using a wireless telemetry surface electromyography.

For the patients in the rest control group, the patients were allowed to rest for 5 minutes after the first modeling was completed. However, for those in the foulage group, a 5-minute massage treatment will be performed with highly qualified tuina specialists after the first modeling. Press the thumb on the patient's left tibialis anterior muscle and rub it repeatedly up and down. Meanwhile, focus on the following acupuncture points, namely the Zusanli, Yanglingquan, Shangjuxu and Fenglong points. Pay attention to the patient's feelings, and adjust the strength to ensure the comfort degree.

Myoelectric signal is the muscle action potential recorded by electrode, which detects indicators closely related to the degree of fatigue, including integrated electromyography, maximal amplitude, slope, and median frequency. First the patient's file was built, then the left tibialis anterior muscle was chose for testing. The reference electrodes were placed on the bony mark, namely the tibial tuberosity, and then the test was performed according to the selected program (Wroblewska et al. 2015). The test was performed twice, and carried out simultaneously with the modeling test.

Statistical analysis was performed using SPSS21.0. All quantitative data were expressed in the form of mean ± standard variance ($\bar{x}$ ±s), and comparisons were made with t-test. Enumeration data were expressed in the form of natural number (n) + percentage (%), and comparisons were made with chi-square test. $P < 0.05$ represents the intergroup difference was of statistically significance.

III Results

As shown in Table 1, various indexes of both groups were compatible, with no significant difference found ($P > 0.05$). the integrated electromyography, maximal amplitude, median frequency and slope

Table 1. Observation of the surface electromyography before treatment ($\bar{X}$ ±s)

Groups	Indexes	Values
Control group (n=70)	Integrated electromyography	211.49±150.76
	Maximal amplitude	55.68±10.42
	Median frequency	31.29±20.52
	Slope	65.04±111.28
Research group (n=70)	Integrated electromyography	185.93±149.05
	Maximal amplitude	50.93±9.52
	Median frequency	87.99±32.10
	Slope	56.77±11.90

As shown in Figure 2 and Figure 3, the patients were double-checked after 5 minutes of rest. Results showed that the maximal amplitude and gain ratio, integrated electromyography and gain ratio, median frequency and gain ratio, as well as slope and gain ratio were greatly reduced ($P < 0.05$). With administration of foulage, the above indexes were all markedly increased in the research group ($P < 0.05$).

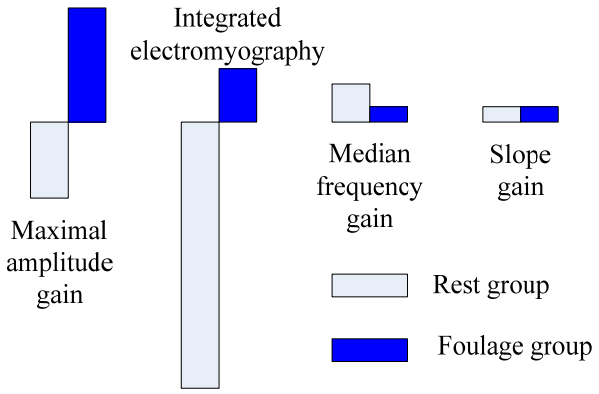

Fig 2. The effect of foulage on the gain of myoelectric signals in tibialis anterior

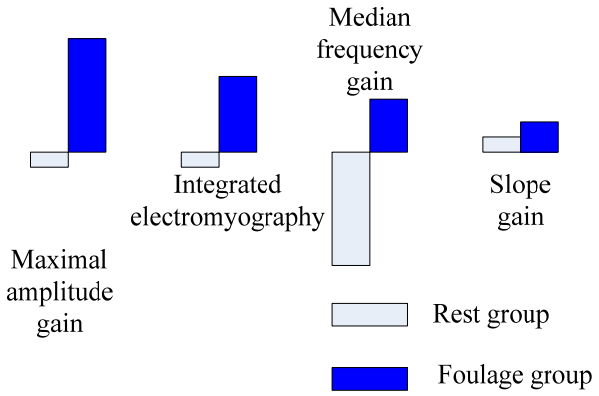

Fig 3. The effect of foulage on the gain ratio of myoelectric signals in tibialis anterior

IV Discussion

Exercise fatigue of tibialis anterior muscle occurs frequently in gymnasts. However, stress damage would be induced once in-time rest or targeted treatment fails, seriously affecting the patient's normal life quality and exercise training (Zheng and Chen 2018). A large number of studies have shown that the frequency characteristics of myoelectric signals vary with the functional status of muscle during muscle work, hence the integrated electromyography, maximum amplitude, median frequency, slope and other myoelectric time domain indicators are sufficient in recognizing fatigue, with ideal validity and reliability(Abdel et al. 2016, Hazra et al. 2015). The results of this study demonstrated that with increased frequency of ankle flexion and extension exercise, there was significant reduction of integrated electromyography, maximum amplitude, median frequency and slope in the tibialis anterior muscle in both groups. Meanwhile, the integrated electromyography of the fatigue muscle was markedly elevated. Moreover, there is a significant positive correlation between amplitude, intensity and slope, as well as reduction in the median frequency.

When the patient suffered from muscle fatigue, the transferring way of maximum amplitude of myoelectricity is from high frequency to low frequency. When the fatigue leads to failure in work, the same final value is obtained. When the maximum contraction force is reduced to 50%, and the corresponding center frequency drop curve displayed typical fatigue sensitivities, which further showing the degree of fatigue. The foulage group strictly follows the theory of traditional Chinese medicine. The selected acupoints include the stomack meridian of foot-yangming, the yanglingquan, zusanli, shangjuxu and honglong of the gall bladder meridian, which significantly

improve the patient's symptoms. At the same time, the surface electromyogram presented with benign changes, suggesting that the muscle fatigue can be well-relieved through the improvement of local blood circulation.

V Conclusion

In summary, application of foulage therapy significantly relieved muscle fatigue. Meanwhile, surface electromyography and isokinetic testing had high scientificity and rationality in evaluating the therapeutic efficacy of foulage in the treatment of tibialis anterior athletic fatigue in gymnast. After the treatment of foulage, the patient's maximum amplitude and its gain rate, integrated electromyography and its gain rate, median frequency and its gain rate, slope and its gain rate are increased by a higher degree than the rest group, suggesting that foulage therapy actively improved the anterior muscle myoelectric signals. It may be due to the effective compensation of the fast muscle fiber during the reduction of slow muscle fiber discharge. Moreover, under isokinetic velocity, the slow muscle fiber and the fast muscle fiber can be well recruited to form a large torque and increase the muscle strength, thereby enhancing the tibialis anterior muscle strength and improving muscle fatigue. In addition, given the limited sample size in this study, a large sample size study should be conducted in the future, in an attempt to more fully support the results of this study.

References

Abdel MS (2016) Design and synthesis of some substituted thiazolo [3,2-a] pyrimidine derivatives of potential biological activities. Saudi Pharmaceutical Journal 24 (2): 119-32.

Attari Z (2016) Enhanced ex vivo intestinal absorption of olmesartan medoxomil nanosuspension: Preparation by combinative technology. Saudi Pharmaceutical Journal 24 (1): 57-63.

Hazra M (2015) Designing polymeric microparticulate drug delivery system for hydrophobic drug quercetin. Saudi Pharmaceutical Journal 23(4): 429-36.

Wang Z, Qin W, Wei CB, Tang Y, Zhao LN, Jin HM, Li Y, Wang Q, Luan XQ, He JC, Jia J (2018) The microRNA-1908 up-regulation in the peripheral blood cells impairs amyloid clearance by targeting ApoE. International Journal of Geriatric Psychiatry 33(7): 980-986.

Wroblewska K (2015) Characterization of new eye drops with choline salicylate and assessment of their irritancy by in vitro short time exposure tests. Saudi Pharmaceutical Journal 23 (4): 407-412.

Xie QJ, Jiang Z, Luo QL (2016) Relationship between root mean square and muscle isometric contraction moment of quadriceps EMG in normal population. Journal of Rehabilitation 26 (03): 25-28.

Zheng W, Chen L (2018) The Roles of Attentional Shifts and Attentional Reengagement in Resolving The Spatial Compatibility Effect in Tactile Simon-like Tasks. Scientific Reports 8 (8760).