NERVE CONDUCTION VELOCITY INVESTIGATION IN ATHLETES WITH TRAINED LOWER EXTRAMITY FOR WELL-CONTROLLING MOVEMENT

Yi-Ming Huang[1], Ya-Ju Chang[2] and Chung Hsun Hsieh[2]
[1]Institute of Coaching science, National College of Physical Education and Sports, Tao-Yuan, Chinese Taipei
[2]Department of physical therapy & Graduate Institute of Rehabilitation Science, Chang Gang University, Tao-Yuan, Chinese Taipei

Reaction, coordination and speed ability are essential for success in a variety of sports. Nerve conduction velocity (NCV) is related to all of these abilities. Previous studies had investigated power and endurance type athletes, but there is less research in athletes who are skilled in coordinated lower extremity movements requiring more neural adaptation for nerve conduction velocity after specific exercise training. The purpose of this study is to investigate nerve conduction velocity of soccer, sanshou players and untrained subjects. Results show that NCV was significantly different among the 3 groups ($p < .05$) for the femoral and tibal nerves. For both femoral and tibial nerves, results showed that the soccer players had significantly faster NCV than the other groups ($p < .05$). According to the results, faster NCV adaptation from long term training in soccer players may be relate to their movement requirement of changing their movement direction quickly and skillfully.

KEY WORDS: nerve conduction velocity, soccer, sanshou

INTRODUCTION: Reaction, coordination and speed ability are essential for sport. All of above ability are related to nerve conduction velocity (NCV). NCV is a measure of speed of pulse can be transmitted along a motoneuron. A rapid NCV is also an indicator of a short refractory period. In turn, the decreased refractory period may allow for greater impulse frequency, thereby increasing muscle activation levels (Moyano & Molica, 1980). Some studies suggest strength and power athletes have faster NCV than endurance athletes (Kamen et al, 1984). However, it has also been reported that no differences were evident between power and endurance groups (Sleivert et al. 1995). Other researchers have shown that trained individuals have faster NCV than untrained ones. (Hoyle & Holt, 1983). Clearly the literature to date has left this point unresolved. In theory, changes in NCV may be an indicator of nerve system adaptation due to long-term training. Previous studies used rhymed exercises, like running and swimming, or powerful exercise, like weightlifter, for testing their lower extremity's NCV. But it is more meaningful and interesting to test kicking movement players, like soccer and sanshou players that need to control their lower extremities accurately and speedy. Therefore, the purpose of this study is to investigate nerve conduction velocity of soccer, sanshou players and untrained subjects and to realize whether their neural specification would change from long term lower extremity training.

METHODS: Subjects of college age participated in the experiment. The subject groups and their physical characteristics are shown in Table 1. Informed consent was obtained from all subjects. Many of athletes ranked in middle-elite and upper-elite category. The data were collected in 2 separated places, wherein the room temperatures were 25.9 ± 0.2 ℃ (sanshou) and 25.1 ± 0.1℃(soccer), respectively. The orders of testing (posterior tibial nerve and femoral nerve) were balanced. The dominant leg was selected for testing. Nerve conduction velocity was assessed using the traditional double stimulation technique (Smorto & Basmajian, 1979). Square pulses of 0.1 ms duration and of sufficient intensity to evoke a supramaximal compound muscle action potential were applied at each stimulus point with surface stimulating electrodes. The subject lay on a table with the straight leg as femoral nerve was tested. The femoral nerve was stimulated at the femoral triangle and abductor canal. Recording electrode was placed on vastus medialis. Ground electrode was on patella (Echternach 2003). At tibial nerve testing, the subject was prone on a table with the straight leg. Conduction velocity of the knee-to-ankle nerve segment was measured by stimulating at the knee on the medial aspect of the popliteal fossa and at the ankle behind the medial malleolus. Muscle compound action potential was recorded at the abductor hallucis. Once the proximal and the distal stimulation location were chosen, five latency measurements were made at each point. Nerve conduction velocity was computed as the distance between proximal and distal stimulation points, divided by the difference between proximal and distal stimulus latencies (Smorto & Basmajian 1979). The data of all untrained subjects were collected in the laboratory, wherein the room temperatures was 26.5 ± 0.2 ℃. 2 between-day reliability tests of NCV test were held. Differences between the groups were identified using ANOVA and Schiffs method with a significance level of $p < 0.05$.

Table 1 Physical characteristics of control, soccer and sanshou players (Mean ± SD).

Group	N	Age (yrs)	Height (cm)	Weight (kg)
Soccer	21	20.6 ± 1.3	174.9 ± 5.5	68.6 ± 6.6
Sanshou	10	22.1 ± 1.0	175.0 ± 5.0	68.5 ± 8.1
Untrained	7	21.5 ± 1.6	172.2 ± 4.5	68.1 ± 4.1

RESULTS: For the control group (N=7), there were no significant differences among test days for either femoral or tibial NCV ($p > .05$). A reliability analysis revealed between-day correlations of $r = 0.92$ for femoral nerve and $r = 0.88$ for the tibial nerve. The result of ANOVA showed that NCVs of femoral and tibal nerve were significantly different among 3 groups ($p < .05$). Results showed that the soccer players had the fastest NVCs.

Table 2 Nerve conduction velocity results of the femoral and tibial nerve.

	Femoral nerve (m/s)	Tibial nerve (m/s)
Soccer	60.5 ± 7.9	49.2 ± 5.1
Sanshou	57.7 ± 3.7	46.6 ± 2.4
Untrained	54.3 ± 1.2	43.1 ± 2.0

DISCUSSION: In the presented study, the results showed that both soccer players and sanshou players had faster NCV than untrained subjects. The result was reasonable, since the goals of Soccer and sanshou training are known as rapid and coordinate movement. Sale et al (1982) have shown that individuals who undergo limb immobilization for 5 weeks prior to 18 weeks of strength training demonstrate faster median nerve conduction velocity following training. As more agility and coordination training by legs was evidence in soccer training, it may cause more physiological adaptation in nerve structure for soccer players. Gerchman et al. (1975) indicated that ventral motoneurons following long term exercise had histochemical changes. The changes in NCV may be indicative of adaptations in the nerve structure such as increased axon diameter and myelination (Ross et al. 2001).

CONCLUSION: Current evidences indicate that long term training is important for increasing NCV. But the types of training may have different levels of adaptation.

REFERENCES:

Echternach JL. (2003). Introduction to electromyography and nerve conduction testing. SLACK Incorporated, New York.

Gerchman, L.B., Edgerton, V.R., Carrow, R.E. (1975). Effect of physical training on the histochemistry and morphology of ventral motor neurons. *Exp Neurol*, 49, 790-801.

Hoyle R.J., Holt LE, (1983). Comparison of athletes and non-athletes on selected neuromuscular tests. *Aust J Sport Sci.* 3(1),13-18.

Kamen, G., Taylor, P., & Beehler, P. (1984). Ulnar and posterior tibial nerve conduction velocity in athletes. *Int J Sports Med*, 5, 26-30.

Moyano HF & Molica JC. (1980). Axonal projections and conduction properties of olfactory peduncle neuron's in the rat. *Exp Brain Res*, 39(3), 241-248.

Ross, A. Leveritt M. & Riek S (2001). Neural influences on sprint running: training adaptations and acute responses.*Sports Med*, 31(6), 409-25.
Smorto M.P., Basmajian J.V. (1979). In Baltimore, William & Wilkins. (ed. 2), *Clinical electroneurography.*
Sale. D. G., McComos, A. J., MacDaugall, J. D., Upton, A. R. M. (1982). Neuromuscular adaptation in human thenar muscles following strength training and immobilization. *J Appl Physiol*, 53: 419-424.
Sleivert GG, Backus RD & Wenger HA (1995). Neuromuscular differences between volleyball players, middle distance runners and untrained controls. Int *J Sports Med* 16(6), 390-398.