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Research Article

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A pilot study on planar pressure characteristic during footwork of table tennis

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ABSTRACT

To study foot pressure distribution of the three basic footwork of table tennis as striding step、level step and sideway step, to provide parameters of table tennis foot technology. Adopted the Novel Emed pressure distribution measurement system, six table tennis players received the measurement of dynamic foot pressure distribution during striding step、level step and sideway step, comparative analysis pressure changes of nine areas. For striding step, heel, the 1st metatarsals and the 1st phalange were larger pressure. For level step, heel, the 1st metatarsals, the 2nd and the 1st phalange were larger pressure. For sideway step, heel and the 1st phalange were larger pressure. Pressure-time curve of three kinds of footwork were obvious difference. Heel of three kinds of footwork showed peak pressure. Striding step the 1st metatarsals and level step the 2ndt metatarsals Ft was larger, damage risk was the relatively high. For level step, forefoot pressure was larger and continued for a long time, the body gravity moved forward, the body quickly turn.

Key words: table tennis; plantar pressure; footwork

INTRODUCTION

The close coordination of footwork and hand-work is an essential component of the table tennis technique, and the footwork is also the hinge of using and connecting techniques accurately and timely, as well as the insurances of tactical [1-3]. The speed of movement and representation are both associated with the force exerted during pushing off [4]. In addition, the greater force results in more agile variation of the center of gravity with faster movement of the body [5]. However, there is currently insufficient research on plantar pressure of table tennis footwork. The present paper provides a detailed analysis of the pressure variation, the relationship between plantar pressure and time and the comparison of the impulse of each area of the three type of basic table tennis footwork.

EXPERIMENTAL SECTION

Six male table tennis players who had no history of lower limb pathology were recruited (age: 22±1.7years; height: 177.0±4.1cm; mass: 65.8±8.7kg). Adopted three basic footwork of table tennis including striding step, level step and sideway step. One of these subjects was habituated to holding bat with left hand, and others were all with right hand. Therefore, relevant force data of the dominant foot were acquired. Plantar pressure was assessed using a plantar pressure distribution measuring plate (Novel Emed, Germany).

The force plate was placed flatwise. All the subjects were required to keep barefoot to test with striding step, level step and sideway step respectively, and each subject performed 3 trials. Plantar pressure distribution system can acquire the plantar pressure distribution data during the whole gait cycle. Data collection and analysis were conducted with the included software Novel Database. Nine anatomical areas per foot were distributed as: heel (M1), arch (M2), the 1st metatarsals (M3), the 2nd metatarsals (M4), the 3th metatarsals (M5), the 4th metatarsals (M6), the 5th metatarsals (M7), the 1st phalange (M8), other phalange (M9) (Fig1).

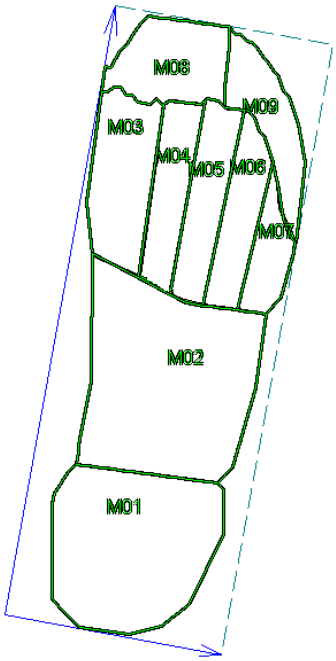

Figure 1 Nine areas of plantar distribution

Data of pressure distribution and pressure-time were displayed by database analysis software. All data were undertaken using SPSS13.0, and were assessed for normality using simple descriptive statistics. Comparison between groups was assessed using Paired Samples T Test.

RESULTS

Heel, the 1st phalange and the 1st metatarsals were large mean peak pressure. It showed different pressure trend for striding step, level step and sideway step. For striding step, the pressure values were as follows: heel, the 1st phalange, the 1st metatarsals, the 2nd metatarsals, other phalange, arch, the 3th metatarsals, the 5th metatarsals and the 4th metatarsals. For level step, the pressure values were as follows: the 1st metatarsals, the 2nd metatarsals, the 1st phalange, heel, other phalange, the 5th metatarsals, arch, the 3th metatarsals and the 4th metatarsals. For sideway step, the pressure values were as follows: heel, the 1st phalange, the 1st metatarsals, the 2nd metatarsals, the 3th metatarsals, other phalange, the 4th metatarsals, arch and the 5th metatarsals (Fig.2).

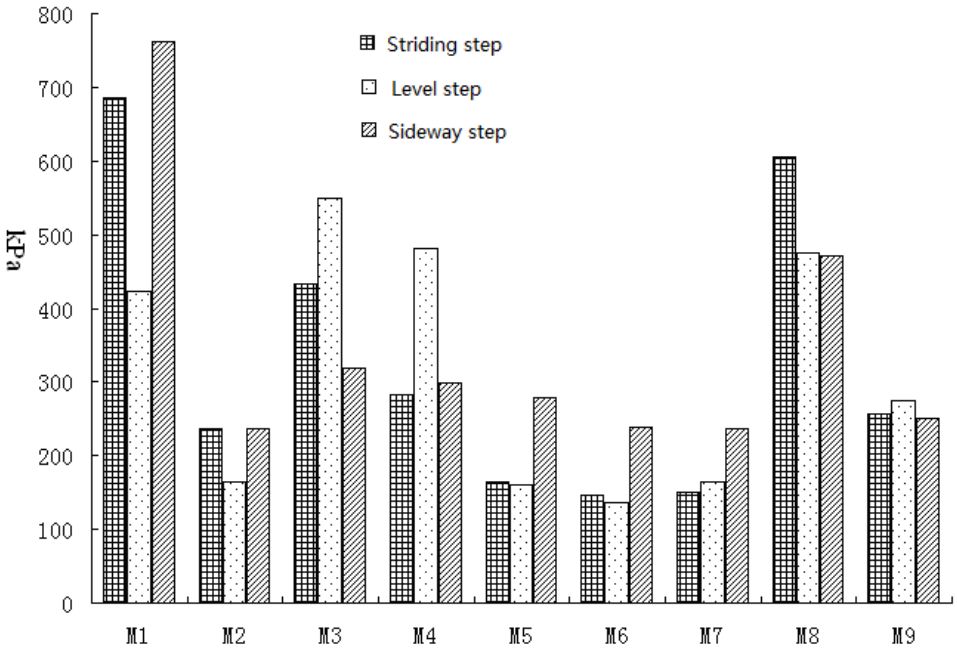

Figure 2 Pressure comparison of striding step, level step and sideway step

The pressure-time curves demonstrated that a small peak at the initial moment of pressure was at the heel. With the movement of the center of gravity, the peak pressure showed respective characteristics. For striding step, the greatest peak pressure occurred before push-off. From the heel strike to the midstance, the pressure increased rapidly, and at the toe-off stance the pressure peaked, which was experienced at the 1st phalange.

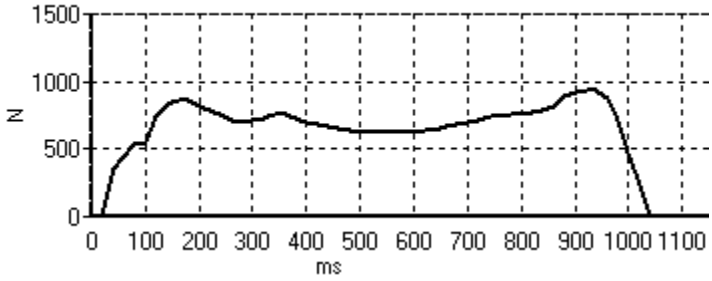

Figure 3 Force of striding step-time

For level step, the pressure-time curve presented a bimodal distribution, the peak pressure is the interaction force, and later decreased during midstance, while peaked secondly later at the 1st metatarsals and the 2nd metatarsals, the center of gravity moved to one side of the body.

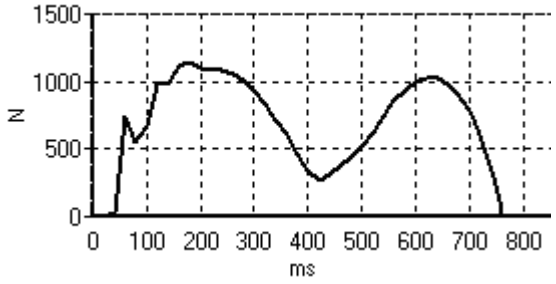

Figure 4 Force of level step-time

For sideway step, the 1st phalange and the 1st metatarsals were the largest plantar pressure. The contact time between heel and ground was short so that the pressure moved to forefoot rapidly and decreased with toe-off.

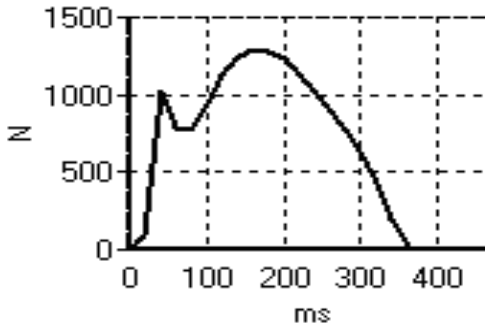

Figure 5 Force of sideway step-time

Table 1 Impulse of each plantar area as striding step, level step and sideway step

	striding step	level step	sideway step
heel	140.4±70.9	154.9±73.8	86.4±66.7
arch	73.6±48.6	66.3±29.7	40.5±25.5
the 1st metatarsals	117±48.1*	95.2±34.1*	55±57.6*
the 2nd metatarsals	87.8±27.9*	103.3±24.1**	50.7±37.4*
the 3th metatarsals	58.2±17.5	60.8±21.0*	42.3±22.5
the 4th metatarsals	45.0±18.1	41.7±16.2	32.9±12.7
the 5th metatarsals	20.1±11.1	16.3±6.7	15.5±9.2
the 1st phalange	68.6±34.6**	38±19.4	27.1±25
Other phalanges	28.7±9.3	24.6±7.1	21.5±3.2

**Compared with the same area P <0.05; **Compared with the same area P <0.01*

DISCUSSION

Table tennis is a sport with the characteristics of agile reaction and quick adjustment of orientation, which needs maintain balance through the center of gravity [7]. The present study indicated that medial forefoot as 1st metatarsals, the 2nd metatarsals and the 1st phalange displayed lager plantar pressure, which is consistent with what observed previously.

The pressure is an effective index of preventing relevant tissue of plantar from injury due to high stress. The finding of significant greater pressure at the 1st metatarsals and the 2nd metatarsals for level step than striding step and sideway step results from fore rake of the center of the gravity and contraction of Achilles tendon to maintain balance with medial forefoot and prepare for changing the body orientation. From the perspective of pressure variation trend, there is no significant differences between striding step and sideway step, while the pressure of metatarsals increases for level step, which also suggested that the stress of forefoot is lager for level step.

Impulse refers to the effect of forces accumulated continuously to each area of plantar in limited time, and impulse of each area of plantar is influenced by the force and contact time. Therefore, it is important to study on the impulse to explain foot injury. Comparing the distribution of the three type of footwork (table 1), heel showed the greatest impulse. It is because of compact construe of calcaneus and thick soft tissue, which protects the heel through counteracting a part of ground reaction force. The peak impulse shifted to the 1st metatarsals and the 2nd metatarsals and the 1st phalange after transiting from arch to forefoot. The impulse of the 1st metatarsals and the 1st phalange were significantly larger for striding step and the 2nd metatarsals were significantly larger for level step. The stretch of Achilles tendon for a long time during stance phase of forefoot easily leads to fatigue and serious abrasion of forefoot of the sole. Therefore, sneakers with damping system on forefoot are conductive to protect the foot by decreasing the ground reaction force [6, 8].

CONCLUSION

The pressure mainly distributed at 1st metatarsals and the 2nd metatarsals and the 1st phalange for all these three footwork with lager impulse value, and the foot injury is highly related to the shift of center of gravity. In consequence, in the process of table tennis training, it is of importance to enhance the stretch training of the muscle and tendon of the lower limb and the foot. When the ground reaction force is excessively large, muscle stretches quickly to shorten the time to reduce the harm of impulse. Secondly, the adjustment of the body center of gravity is a key factor, effective adjustment of the feet while turning fast not only can help exert technique movements, but also prevent the athletic injury.

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REFERENCES

[1] A. De Cock, J. Vanrenterghem, T. Willems. *Gait & Posture*, **2008**, 27(4), 669-675.
[2] H. B. Kitaoka, X. M. Crevoisier, K. Harbst. *Archives of Physical Medicine and Rehaillitation*, **2006**,87(1), 130-135.
[3] N. Pinsault, N. Vuillerme. *Medical Engineering & Physics*, **2009**, 31(2), 276-286.
[4] Y.D. Gu, J.S. li, Y.C. Lu, B. Zhang. *China Sports Science*, **2005**, 11, 85-87.
[5] A. Höhne, C. Stark, G.P. Brüggemann. *Clinical Biomechanics*, **2009**, 24(3), 308-313.
[6] A.P. Ribeiro, F. Trombini-Souza, V.D. Tessutti. *Clinical Biomechanics*, **2011**, 26(2), 194-199.
[7] J. Wu, J.S. Li. *China Sports Science*, **2006**, 26 (6), 67-70.
[8] H. Yang, *Journal of Chemical and Pharmaceutical Research*, **2013,** 5(12), 296-301