STUDY ON STRIDE LENGTH, RATE, ANS SPEED OF 100m SPRINTE RUNNING WITH FIVE KINDS OF SPEED

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Studying on sprint not only is important to this event itself, but also will accelerate the development of other events. Speed is an important index in sprint event and it is relate to stride length and stride rate. In this paper, we studied and analyzed the relationship of stride length. stride rate and speed of seven sprinters when the subjects run with five kinds of speed. In the trial, we filmed the technique of seven athletes with M9500 normal speed camera and got the data with which we analyzed the technique using SHIXUN image analysis system. The results show: (1) it is correct that seven athletes grasp gradual increase of speed, which prove that the choose of the athletes is believable; (2) when the speed increases, the stride length and the stride rate change with different extent. But on the whole, it's tendentious. (3) When speed increased, stride length was the primary factor at low speeds while stride rate was the primary factor at high speeds. We suggest that seven athletes in this study should pay attention to strengthening the exercise of increasing the stride rate in usual training.

KEY WORDS: 100m sprinter, speed, stride length, stride rate, low speeds, high speeds.

INTRODUCTION: In our country, field and track always lies in a lagged position. As the foundation of field and track, sprint event is very important. So making research on it not only is important to sprint event itself, but also will accelerate the development of other events. Speed is an important index in sprint event and it is relate to stride length and rate. The purpose of this paper is to study the relationship of stride length and sport speed, stride rate and sport speed when the subjects run with five kinds of speed, to put forward the approach of improve the speed, thereby directing training.

METHODS: To make study and analyze on kinematics character of technique using M9500 normal speed camera and SHIXUN image analysis system.
There are seven sprinters. Firstly athletes ran freely about 20 meters individually. In the range of 20m-26m, they ran with five kinds of speed and their movements were filmed. The distance from the camera to movement plane was about 35m. The filming frequency is 50HZ. The subjects were demanded running with five kinds of speed, that is, the slowest velocity, the slower velocity, the moderate velocity, the faster velocity and the fastest velocity. In each instance, M9500 normal speed camera was mounted on a tripod positioned to provide a side view of the participant, and performances at a constant speed were recorded. A surveyor's rod was filmed in the participant's plane of motion prior to the first trial to provide a liner scale for subsequent digitizing.
To convert the image filmed into the data on with SHIXUN image analysis system and make analysis on the technique of the athletes according to these data.

RESULTS AND DISCUSSION: seven subjects ran with the five kinds of velocity respectively. The variational situations of speed, stride length and stride rate were listed in table1, table 2 and table 3.

Table 1 Five kinds of speed of the athletes.

speed / name	The slowest _m/s_	Slower _m/s_	Moderate _m/s_	Faster _m/s_	The fastest _m/s_
Shuo zhang	6.1091	6.3565	7.5361	8.5427	9.4271
XW Huang	6.2640	7.2045	7.5570	8.6037	9.0743
XL Li	4.3242	5.6128	6.7434	7.5631	8.6602
Wei Hunag	3.8786	5.4752	6.5623	7.1339	8.3698
Yujia Tao	4.5944	5.3741	6.5285	7.7759	9.0526
Yan Li	4.6952	5.6879	6.5049	7.9466	9.0894
Hao Wang	4.3951	6.3444	6.5049	7.9466	9.5872

In this trail, the athletes themselves controlled speed. The speed values in table 1 show that the speed values of every athlete are all from small value to large value, which fits to the demand of the trail. It is obvious that the feeling of the athletes for speed is all more exact.

Table 2 Stride length of the athletes.

name	When speed is the slowest (m)	ΔL/L	When speed is slower (m)	ΔL/L	When speed is moderate (m)	ΔL/L	When speed is the faster (m)	ΔL/L	When speed is the fastest (m)
Shuo Zhang	2.0897	-0.0469	2.0399	0.0578	2.2803	0.0369	2.3644	-0.0875	2.1576
XW Huang	2.1492	0.0526	2.2623	-0.04	2.1710	0.0225	2.2198	-0.0098	2.198
XL Li	1.5111	0.2748	1.9263	-0.057	1.8159	0.2514	2.2725	-0.0440	2.1726
Wei Huang	1.3942	0.2863	1.7933	0.2268	2.0000	0.0402	2.0804	-0.0406	1.9959
Yujia Tao	1.4521	0.1355	1.6489	0.1223	1.8506	0.1235	2.0791	0.0192	2.1190
Yan Li	1.6663	0.1186	1.8639	0.1641	2.1697	0.0193	2.2116	-0.0975	1.9960
Hao Wang	1.5148	0.2788	1.9371	0.1331	2.1395	0.1010	2.3550	-0.1134	2.0659

*Here the stride length(L) refers to the distance between the toe of a foot take-off and the toe of other foot take-off. ?L/L refers to the increased rate of the stride length.

Table 3 Stride rate of the athletes.

name	When speed is the slowest (strides/s)	ΔR/R	When speed is slower (strides/s)	ΔR/R	When speed is moderate (strides/s)	ΔR/R	When speed is the faster (strides/s)	ΔR/R	When speed is the fastest (strides/s)
Shuo Zhang	2.7778	0.1250	3.1250	0.0667	3.3333	0.0714	3.5714	0.3997	5.0000
XW Huang	2.7778	0.0588	2.9412	0.1333	3.3333	0.1539	3.8462	0.0833	4.1667
XL Li	2.9412	-0.181	2.3810	0.4000	3.3333	-0.167	2.7778	0.0588	2.9412
Wei Huang	2.2727	0.1000	2.5000	0.2500	3.1250	0.0667	3.3333	0.5000	5.0000
Yujia Tao	2.7778	0.3846	3.8462	-0.071	3.5714	0.0769	3.8462	0.1818	4.5455
Yan Li	2.6316	0.0556	2.7778	0.0588	2.9412	0.1333	3.3333	0.2500	4.1667
Hao Wang	3.5714	0	3.5714	0.0769	3.8462	0.0833	4.1667	0.0909	4.5455

ΔR/R is the increased rate of the stride rate.

Figure 1 and figure2 shows the varying curves of their stride length and rate vs speed:

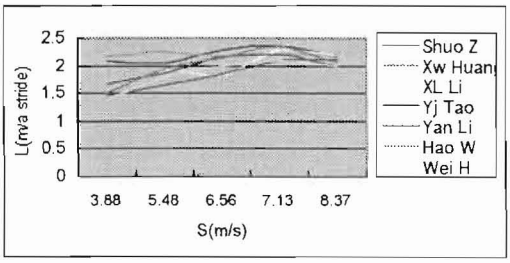

Figure1: stride length vs Speed curve.

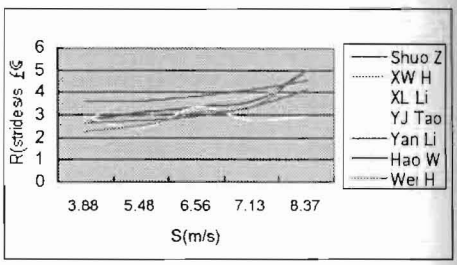

Figure2: stride rate vs Speed curve.

It can be seen from figure1 and figure2 that when speed increases, for Yujia Tao, stride length increase; For Wei Huang, Yan Li and Hao Wang, the stride length increases firstly, then decreases. For Shuo Zhang, Xingwei Huang and Xianglong Li, the stride length changes irregularly, but the total trend is increasing firstly, decreasing then. The change of stride rate: when speed increases, for Shuo Zhang, Wei Huang and Yan Li, stride rate increases. For Xingwei Huang, increases firstly, keeps steady then; for Hao Wang, keeps steady firstly, increases then; for Yujia Tao, increases firstly, decreases slightly then, but increases later. For Xianglong Li, the stride rate changes irregularly.

For the sake of brevity, let R?L and S0 equal to the initial stride rate, stride length, and speed, respectively; Let ?R and ?L equal to the change of stride rate and stride length, respectively, both over a specified interval; And finally, let S equals to the final speed. The absolute change in speed over a specified interval is given, in terms of the products of the final and initial stride rates and stride lengths, by:

$$S- S_0=(R+\Delta R)(L+\Delta L)-RL$$
$$=RL+R\Delta L+L\Delta R+\Delta R\Delta L-RL$$
$$= R\Delta L+L\Delta R+\Delta R\Delta L$$

And the change in speed relative to initial speed by:

$$(S- S0)/ S0=(R\Delta L+L\Delta R+\Delta R\Delta L)/RL= \Delta L/L+\Delta R/R+\Delta R\Delta L/RL$$

When the above equation is multiplied by 100%, the percentage change in S is seen to be equal to the sum of the percentage change in stride rate, the percentage change in stride length, and the typically very small percentage change in the final term. From this it can be seen that the factor with the greater change makes the greater contribution to the change in S. as already defined, this is the primary factor.

Through this relationship, we can identify the situation of every athlete.

The changing trend of every athlete is as follows:

1.from the smallest speed to smaller speed: Shuo Zhang improves the speed through increasing the stride rate, Xianglong Li and Hao Wang, through increasing the stride length, Wei Huang and Yan Li, primarily through increasing the stride length, Xingwei Huang and Yujia Tao primarily through increasing the stride rate.

2.from the smaller speed to moderate speed: Xingwei Huang and Xianglong Li improve the speed through increasing the stride rate, Yujia Tao through increasing the stride length, Yan Li and Hao Wang primarily through increasing the stride length, Shuo Zhang and Wei Huang primarily through increasing the stride rate.

3.from the moderate speed to the faster speed: Xianglong Li improves the speed through increasing the stride length, Yujia Tao and Hao Wang primarily through increasing the stride length, Shuo Zhang, Xingwei Huang, Wei Huang and Yan Li primarily through increasing the stride rate.

4. From the faster speed to the fastest speed: Yujia Tao improves the speed primarily through increasing the stride rate, the other six athletes all through increasing the stride rate.
In a paper of James G.Hay "Cycle Rate, Length, and Speed of Progression in Human Locomotion", he refers to a law, that is, for excellent athlete, when speed increased, at low speeds stride length was the primary factor while stride length was the primary factor at high speeds.
In this study, integrating the changing trend of stride length and rate when speed changes, we can see: at low speeds, the state of two persons (Yan Li and Hao Wang) is that the stride length is the primary factor for improving the speed. The state of two persons(Shuo Zhang and Xingwei Huang) is that the stride rate is the primary factor for improving. At high speeds, the state of four persons (Shuo Zhang, Xingwei Huang, Wei Huang and Yan Li) is the stride rate is the primary factor for improving the speed. It is obvious that Shuo Zhang and Xingwei Huang always improve the velocity through increasing the stride rate, for Yan Li, when speed increased, stride length was the primary factor at low speeds while stride rate was the primary factor at high speeds. Wei Huang improves the stride rate earlier while Hao Wang improves the stride rate later. For Yujia Tao and Xianglong Li, their changes were irregular. It is obvious that our research achievement fits to that of James G.Hay.

CONCLUSION: In short, for seven subjects in this paper, when the speed increases, their stride length and speed rate change with different extent. The choosing result of individual is different, but they have orientation. On the whole, when speed increased, stride length was the primary factor at low speeds while stride rate was the primary factor at high speeds. However, for the science services work for sport team, although we may refer to the general law, we should make test on every athlete and identify the training way of this athlete.