ISSN : 0974 - 7435 Volume 10 Issue 4

BioTechnology
An Indian Journal

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BTAIJ, 10(4), 2014 [932-940]

Research on volleyball spiking techniques based on biomechanics and kinetic analysis

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ABSTRACT

Based on the analysis of volleyball spiking action's characteristics of run-up, stop-jump and stroke with winging the arm, this text provides guidance to biomechanics and kinetic analysis on volleyball spiking techniques. Using biomechanical principles to analyze the varying pattern in each joint angle of lower limbs in the process of stop-jump of volleyball spiking technique, to draw the conclusion that the strength training of small muscles and calf muscles should be attached importance to in the process of stop-jump of volleyball spiking technique. Through group experiment and analysis of experiment data, to explore characteristics of biological mechanics parameters of each joint of lower limbs of those knee joint injuries in the process of landing after stroke of jumping after a sudden stop, and then know influence the knee joint damage based on the analysis of angle makes to the buffer and stretch stage of stop-jump.

KEYWORDS

Kinetic characteristics;
Stop-jump;
Whipping effect;
Spiking techniques;
Sport injury.

INTRODUCTION

In the course of volleyball competition, using quality of spiking techniques plays a crucial role in the result of the competition. Spiking techniques are often divided into three steps, i.e. run-up, stop-jump and stroke. Run-up provides speed for stop-jump, stop-jump provides greater momentum for arm swinging, and arm swinging provides power for stroke, so the three steps are closely linked with one another. At the same time, stop-jump serves as a connecting link between the preceding and the following, so a good stroke and scientific stop-jump are inseparable. The text analyzed the biomechanics and kinetic characteristics in the process of stop-jump of volleyball spiking techniques, so as to provide training teaching reference for high-quality spiking.

Many scholars made a study on volleyball spiking techniques, whose views and proposals helped a lot to improve athletes' spiking quality. Yang Chunxia(2013) through three-dimensional high-speed camera and image analytical method, she analyzed human body's gravity center speed, displacement and time in the process of spiking in the back row by one-leg and double-leg take-off, providing feasible suggestion for control of the gravity center of human body in the take-off spike. Lin Yufeng(2014) used the data by Motion Analysis and Kittler to analyze the characteristics of stop-jump action of the knee joint damage members group, proposing the theory of compensatory changes to each joint of lower limbs. Zhang Haibin(2013) used multi-motor syn-

chronous test of force platform, video camera and EMG to collect the data of kinematics, kinetics and EMG in the process of stop-jump, providing feasible proposal for scientific training for athletes.

On the basis of previous studies, this text analyzed the three steps of volleyball spiking, methods of experimental measurement, mathematical statistics and theoretical explanations are used, and the emphasis lies on the analysis of the kinetic parameters of human body's center gravity and biomechanical parameters of each joint of lower limbs in the process of stop-jump, expecting to offer foundation on scientific spike training.

PROCESS ANALYSIS ON VOLLEYBALL SPIKE

Spike technique is the basic in volleyball sport, and it's also one essential means to gain score in the volleyball competition, which can be found out in many volleyball tournament. The process of spike as usually divided into three steps: run-up, stop-jump and stroke with swinging arm. This chapter will elaborate on the techniques of the three steps, expecting to lay a foundation for the analysis of the state of human body in volleyball spike.

Volleyball spike includes three steps: run-up, stop-jump and stroke with swinging arm, as is showed in Figure 1.

Figure 1 is the phrased actions of volley spike. In Figure 1, 1is run-up, 2is stop-jump, 3is stroke with swinging arm.

Run-up

Take-off needs to reach a certain height in the action of spike, generally the higher spike is, the higher the score is, and so athletes pursue to jump higher. However, high jump needs the assistance of run-up, in which process speed and distance determine the height of take-off. So in order to improve the position of stroke point and stroke effect, athletes often control distance and speed of run-up by ball prediction to make preparations for the best stroke. Hence, run-up is step in volleyball spike techniques.

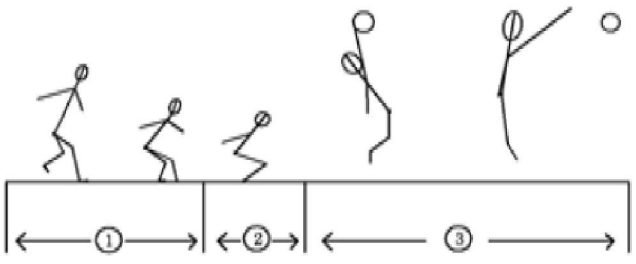

Figure 1 : The phrased actions of volley spike

Stop-jump

Take-off begins with the ending of run-up and ends with feet off the ground, the ending moment of run-up is called the process of stop-jump. In the process of abrupt stop brake, the human body converts a part of horizontal velocity to the speed of the vertical upwards on a shaft of foot, at the same time making an effort ground with one leg or double legs to fully stretch the knee joints and release elastic potential energy the lower limbs reserve, providing initial kinetic energy for athlete's take-off. The greater vertical momentum athlete gains at the feet off the ground, the greater the jumping height will be. In order to improve the athletes' jumping ability, the three-dimensional photographic technique analysis was used in our country to design the best take-off action for each athlete, which to a great extent has improved athletes' jumping ability.

Stroke with swinging the arm

Although the stroke point is hand, arm rotation momentum was needed in order to improve the hitting power; of course it also needs cooperation of all aspects of the body. In the process of practical training of volleyball spiking, arm swinging training is a key link, and it's also the core action in the process of actual spike. Amplitude and speed of volleyball arm swinging affect the direction and force of stroke, so in order to gain scores by effective stroke, athletes always take sharp angle and larger intensity. In addition to strong motion of arms in the process of arm swinging, it also needs driving of lower limbs and body, the opposite movement of lower limbs and body provides counterforce for the body's swing, the body drives shoulder, shoulder drives upper arm and upper arm drives forearm. This series of mechanically driven process is called whipping action from large mass remote to little mass proximal in biomechanics, which offers greater momentum for stroke player.

In the process of momentum transfer from the distal end to the proximal, and the distal end is in large

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mass, the proximal is in little mass, it is the momentum growth principle of whipping, i.e.in the spiking, the elbow's ideal position is above shoulder or at least in the same height with shoulder, in this way the athlete can swing the arm backward for stroke. The structure of shoulder joint determines straight-arm stroke, and the arm's distance is shortened. Look at Figure 2, without bending the body, the arm is nearly vertical to the ground. If C is the stroke point, the working distance of hand is only as long as length of L arc, it is not conducive to speed of arm swinging. If the take-off point is below the ball, it is impossible to spike or cut the ball with straight arm. When the rotary inertia of arm *I* enlarges, the rotating angular velocity *w* decreases, arm length *r* keeps invariant, then according to formula (1), when *w* decreases, hand's linear velocity must decrease, which has a great influence on the power of stroke.

$$\mathbf{V = \omega \cdot r} \quad \textbf{(1)}$$

Figure 4 shows the principle of whipping action, in the process of spike, the upper arm speeds up to the biggest, it brakes at the point B of elbow, the upper arm's angular velocity increases to ω_2, relative to B angular momentum, the distal end segment is M, accelerated velocity β is the change rate of angular velocity, so comes the relations in formula (2):

$$\left.\begin{aligned}\mathbf{M = I_2 \cdot \beta}\\ \mathbf{\beta = \Delta\omega/\Delta t}\end{aligned}\right\} \Rightarrow \omega_2 = \omega_1 + \frac{M\Delta t}{I_2} \quad \textbf{(2)}$$

So formula (3) shows the velocity of distal end segment:

$$\mathbf{V = L_1\omega_1 + L_2\omega_2 + \frac{L_2 \cdot M\Delta t}{I_2}} \quad \textbf{(3)}$$

ANALYSIS OF KINEMATIC CHARACTERISTICS OF GRAVITY CENTER OF HUMAN BODY IN THE PROCESS OF TAKE-OFF SPIKE

Yang Chunkier (2013) pointed out that take-off technique is the key link in volleyball techniques, the technical aspects will directly affect the height and pediment displacement vacated, the effect of the ball has a great impact, while the rear take-off is designed to maximize the use of run-up velocity, kicking and swinging through the various aspects of the human body, and maximizing the jumping velocity and altitude, so as to lay a foundation for effective and high-quality stroke. In the process of take-off spike, stability of the gravity center of human body determines athlete's spike quality. In order to explore the athletes' center gravity changes during the spike from the perspective of kinematics, this chapter aims at analysis of spike process of one-leg or double-leg take off, so as to provide a reference for athletes' best control of body posture in take-off spike.

The research objects and research method

Research object

6 players of a university volleyball league. The basic situation of the research objects as shown in TABLE 1.

Research methods

In this paper, we adopt the three-dimensional high speed camera, Image analysis, comparison method and Mathematical statistics, two high-speed cameras(TM-6710CL) were used in the research. Image analysis tool is The APAS Motion analysis system of Ariel Company. Computational tools of mathematical statistics by

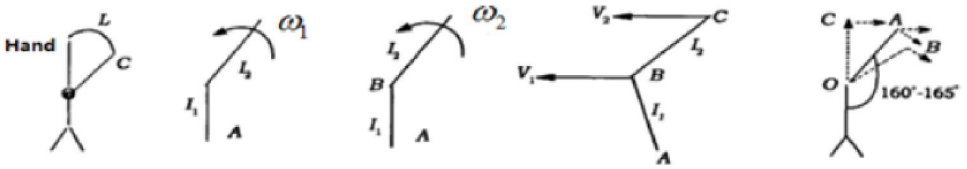

Figure 2 : Physical condition and whipping process when body is not against the bow

TABLE 1 : The basic situation of the research object

Category	Value	Category	Value	Category	Value
Age(y)	23.17±1.47	Weight(kg)	79.83±5.64	Single to reach(m)	3.27±0.05
Weight(m)	1.87±0.03	Hands high(m)	2.45±0.06	Double help touch high(m)	3.23±0.06

SPSS statistical software.

The analysis of body center Kinetic parameters in the process of one foot Spike and two feet spike

The analyzed parameters include: The time parameter of horizontal velocity of the center gravity, Vertical velocity of the center gravity, Displacement of the center gravity, and the takeoff stage. To jump smash the center of gravity in the process of dynamic parameters of in-depth analysis, this paper will focus speed level into the largest B - A - landing buffer when C - stretching from the ground speed reduce the value of E - D - level during horizontal velocity loss rate and speed of the F - leaps six research content, will be the center of gravity vertical speed into H - G - landing maximum buffer when I - stretching from the ground when the added value of J - vertical speed K - vertical speed conversion rate and the content of the L - leaps six Angle research, the focus displacement into the buffer stages M - Z axis displacement N - O - stretching in the X axis displacement phase displacement of the Z axis P - X axis displacement and Q - the center of gravity height from the ground five content were analyzed, and the characteristics of takeoff stage time research into R - S - buffer time stretching and T - takeoff time three contents were analyzed. The following response to these A ~ T kinetic parameters were 15 foot jump smash and feet off Spike analyze data differences, to provide a stable center of gravity athletes rationalization proposals. As shown in TABLE 2 Kinetic parameters of human differences in gravity test results.

In addition, it is concluded that the human body center of gravity is shown in Figure 3 horizontal velocity vertical velocity profile and the body center of gravity displacement variation as shown in Figure 4.

From the data in TABLE 2 and Figure 3 and Figure 4 can draw the following four conclusions:

1) When the athlete do one foot jump smash, the Vertical velocity is smaller than that of two feet. That is to say, the one foot jump smash can relieve the burden on the leg and offer good help for the kicking off leg.

TABLE 2: The Comparative analysis results of body center Kinetic parameters in the process of one foot Spike and two feet spike

Parameter category	one foot Spike	two feet spike	One-Two	T test value	Significant level
A	4.76±0.16	4.42±0.37	0.34	2.077	P>0.05
B	4.02±0.22	3.56±0.21	0.46	3.747	P <0.05
C	3.52±0.29	2.57±0.32	0.95	5.364	P <0.01
D	1.24±0.22	1.89±0.59	-0.65	-2.490	P <0.05
E	25.9±4.95	40.0±9.45	-14.08	-3.232	P <0.01
F	4.49±0.33	4.23±0.22	0.26	2.680	P <0.05
G	-0.32±0.19	-1.06±0.19	0.64	6.808	P <0.01
H	1.35±0.10	0.95±0.59	0.40	1.550	P >0.05
I	2.79±0.18	3.35±0.17	-0.56	-5.557	P <0.01
J	2.46±0.25	2.29±0.09	0.17	1.519	P >0.05
K	51.13±5.8	50.30±3.84	0.83	0.295	P >0.05
L	38.4±1.46	50.4±4.68	-12.0	-6.001	P <0.01
M	0.15±0.03	0.07±0.03	0.08	4.940	P <0.01
N	0.48±0.08	0.77±0.16	-0.29	-3.948	P <0.05
O	0.33±0.04	0.28±0.05	0.05	1.769	P >0.05
P	0.47±0.09	0.39±0.10	0.08	1.512	P >0.05
Q	1.29±0.03	1.14±0.06	0.15	5.914	P <0.01
R	0.110±0.02	0.189±0.03	-0.079	-5.087	P <0.01
S	0.129±0.02	0.128±0.03	0.001	0.061	P >0.05
T	0.238±0.02	0.352±0.03	-0.114	-7.928	P <0.01

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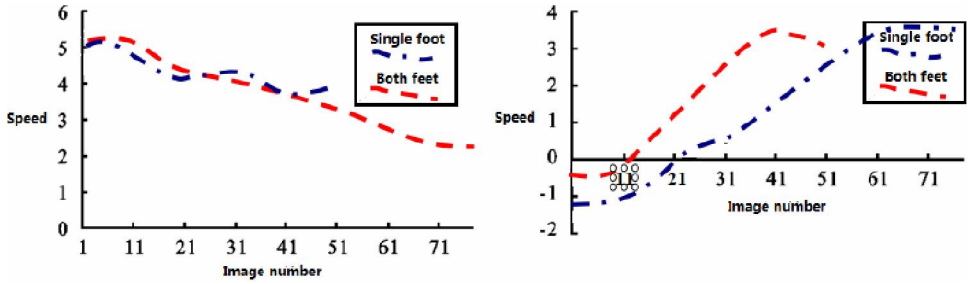

Figure 3 : The change between horizontal velocity and Vertical velocity of body center gravity

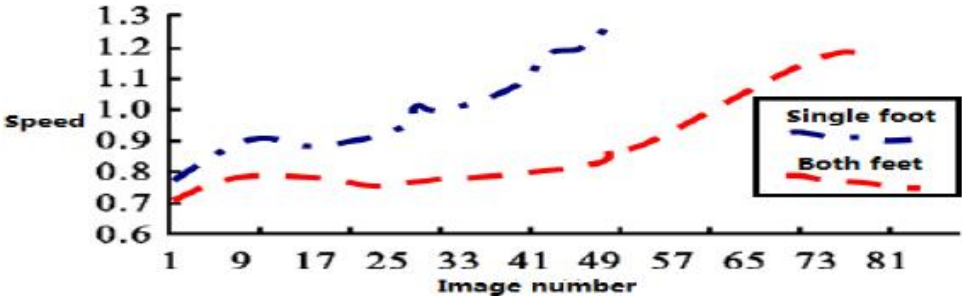

Figure 4 : The displacement variation of body center gravity

2) When the athlete do one foot jump smash, the loss of horizontal velocity is smaller than that of two feet. That proved at the end of one leg kicking off speed is larger than your feet off, so when you grasp one foot off the brake to better effect, and higher levels of run-up speed applications efficiently.
3) Jump on one foot smash the athletes during the process of the human body center of gravity leaps Angle than the feet jump to smaller, jump on one foot at the instant of the land, the human body and has reached the lowest point, science and technology and the support leg knee joint cushion process is a positive process
4) In single foot takeoff and feet jump smash process, both the takeoff time there is a very significant difference, the difference is mainly caused by a buffer time, thus shorten the takeoff time should start from reducing the buffer time

BIOMECHANICAL ANALYSIS OF VOLLEYBALL SPIKING EMERGENCY STOP-OFF PROCESS

FuZhuang(2010) etc. He pointed out that in volleyball tournament, the players spiking, blocking, jumping and hopping to play tee ball level technology plays a key role to the play level. Scientific and rational aspects of the completion of the emergency stop-off is not only well done spiking, blocking, jump serve and jump passing skills are essential critical stage, but also the athletes get a better jump height of the key aspects of the implementation, especially in the spiking technique was more effective application[4]. In order to complete the volleyball player spiking make quality guarantee, from the knee, stop off process hip and ankle biomechanics parameters change in starting this chapter, analyze them, in order to provide for the emergency stop off theory of action norms basis, and then on 12 study subjects plantar pressure testing and EMG test to explore the biomechanical characteristics of the emergency stop off during the buffer stage and kicking stage, providing data base for sports injury prevention athletes.

The research objects and research method

Research object

Emergency action of athletes 4th in the women volleyball from 12 provinces. These athletes are all professional in volleyball. Their average age was 21 years old, average height is 185 cm, average weight is 73 kg. The average working life of 5 years. And we did more strict inspection to the research object, thus they can be a representative sample.

Research method

In this paper, the data is through dynamic testing kinematics and methods of testing and acquisition of power The dynamic test of which is placed in the sta-

dium site 4 4 piece of three-dimensional strain, placed at the scene two data collector and a laptop computer, the frequency of the load table is set to 1000; Kinematic test tools adopted two AG - HMC83MCU high-speed camera and a set of three-dimensional DLT framework; Methods of electric testing tool USES is ME6000 recorded electrical tester using the test tool to get human knee joint angles of the hip Angle of ankle plantar pressure numerical value and muscle electromyography data, the collected data using SPSS statistical software and EXCEL software.

Biomechanical parameters analysis of emergency jump spike

For 12 of the research object of the knee joint Angle tracking, tracking time of 480 ms, let every athlete to the movement of 5 run-up scram takeoff and smash, selecting athlete movement effect is one of the best times, and knee joint Angle change over time of data entry to EXCEL in the table, in order to clearly show 12 athletes knee joint Angle, this paper USES the data from four people a group of images, as shown in Figure 5 number 1-4 athletes knee joint Angle changes, as shown in Figure 6 number 5-12 athletes knee joint Angle changes By figure 5 and figure 6 shows the athlete knee joint Angle changes in the time range of 0-480 ms, the no. 1,2,3,5,7,9,11 athletes in stop takeoff stage and the feet step into load instantaneous high knee flexion Angle, the Numbers for 1,3,7,8,11,12 athletes on stretching stage takes longer, Numbers for 2,4,6,9,10 athletes on the buffer time less time-consuming, only Numbers for 10 athletes knee joint Angle change and stability.

In addition, it concluded the hip joint Angle and the joint angular velocity ankle and in the buffer stage and stretching stage, as shown in TABLE 3.

The data in TABLE 3 shows in the scram jump two movement stage, the tendency of the hip joint and ankle joint increase with the decrease of the first, and the change range of the two joints is smaller, Combined with Figure 5 and Figure 6 shows the hip joint than the ankle and knee into the stretching in earlier stage, after hip stretching stage of knee flexion Angle change, the last stage of ankle angles into stretching, so in volleyball players stop jump training should pay attention to the power of the hip knee and ankle in order to grasp the

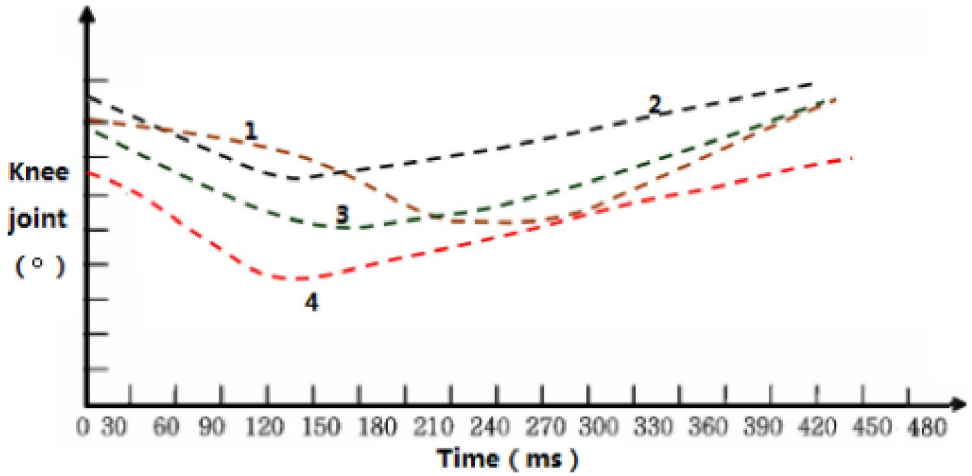

Figure 5 : 1-4 knee flexion Angle changes of numbered athletes

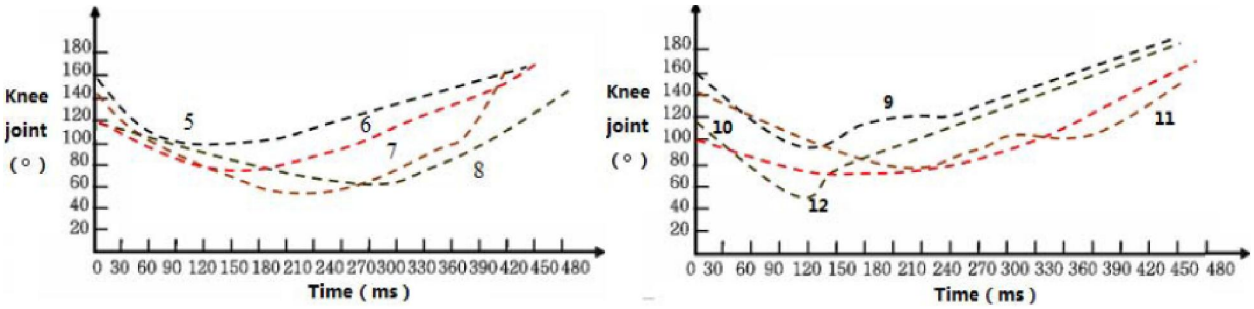

Figure 6 : Knee flexion Angle changes of numbered athletes

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TABLE 3 : List of Emergency-off joints and hip biomechanics parameter of ankle on stage two

Joint category	Biomechanical parameters of the buffer stage		biomechanical parameters of Stretching stage	
	Angle(°)	Angular velocity(°/s)	Angle(°)	Angular velocity(°/s)
hip joint	17.59±5.26	-143.1±31.67	80.17±15.36	784.31±60.12
ankle joint	7.57±4.53	-394.7±47.56	56.71±8.96	901.26±70.34

TABLE 4 : Parameter Figure of plantar pressure and its corresponding body part in the process of take-off in volleyball stop-jump spike

No.	Heels down			No.	Toes down		
	pressure(N)	angle(°)	ratio(N·kg^{-1})		pressure(N)	angle(°)	ratio(N·kg^{-1})
1	706±130	135±31	9.28±1.71	2	721±113	155±23	9.12±1.43
4	730±146	105±33	9.12±1.82	3	740±160	140±20	9.13±1.97
7	701±261	125±40	9.73±3.63	5	760±159	150±26	9.39±1.91
8	708±116	120±27	8.96±1.47	6	670±200	158±25	8.81±2.63
10	712±213	120±30	9.49±2.84	9	620±186	140±43	8.73±2.62
11	680±181	105±36	9.32±2.49				
12	691±156	113±23	9.09±2.05				

Note :Stress refers to the plantar pressure value; Angle refers to the knee flexion Angle; The ratio of ratio refers to the pressure and weight

power of each joint order to improve the jumping ability of athletes

Analysis of EMG features in volleyball stop-jump

In order to improve the economical efficiency of volleyball players' stop-jump spike, this text analyzed the relationship among 12 players' plantar pressure situation, angles of knee flexion and the ratio of pressure and weight, the data is shown in TABLE 4.

From TABLE 4, it can be known that in the course of volleyball stop-jump, players' different heels down ways will produce different plantar pressure and knee flexion angles, and knee flexion degree is the reserve link of human body's elastic potential energy, which directly affects the jumping height of athletes. The data indicates that the toe ground way is better to promote athletes' jumping ability, so emphasis should be put on toe ground design in the following stop-jump training.

TABLE 5 : EMG value of eight major muscles in stage of buffer and kicking off the ground

Category	Buffer stage		Kicking stage		Category	Buffer stage		Kicking stage	
	Mean value	Standard deviation	Mean value	Standard deviation		Mean value	Standard deviation	Mean value	Standard deviation
K1	46.53	15.17	101.3	69.87	K5	30.87	20.65	103.76	39.78
K2	38.62	21.35	90.12	40.83	K6	70.65	38.76	80.92	36.87
K3	56.28	37.67	146.38	97.65	K7	30.61	23.15	127.68	47.82
K4	28.68	18.37	116.27	47.11	K8	15.60	16.53	136.78	61.23

TABLE 6 : The basic condition of effect knee joint damage makes on stop-jump effect

Object group	men with unilateral knee damage	Men without damage	women with unilateral knee damage	women with bilateral knee damage
Sample size(n)	8	13	6	11
Age(y)	20.01±1.28	20.06±0.65	20.03±0.48	20.02±0.68
Height(cm)	190.55±4.52	185.23±6.82	179.43±2.67	177.01±4.98
Weight(kg)	81.73±9.74	83.52±11.11	66.01±5.14	62.45±6.31

By surface electromyography tester ME6000, we learned 12 players' EMG value in the stage of buffer and kicking off the ground in stop-jump: K1-gluteus maximums, K2-biceps femoral, K3-rectus femoral, K4-internal thigh muscles, K5-external thigh muscles, K6-anterior muscle, K7-K8-lateral gastronomies and medial. TABLE 5 shows the 8 muscles' EMG mean value and standard deviation in stage of buffer and kicking off the ground.

From data in TABLE 5, we conclude that contribution rate of lower limb muscles in stage of buffer and kicking off the ground is ordered as follows:

K6>K3>K1>K2>K5>K7>K4>K8

So in the buffer stage, anterior tibia muscle plays a very important role in take-off, training should be focused on small muscles which own a greater contribution ratio in volleyball stop-jump.

In the kicking phase, EMG values of K7-gastrocnemius improved a lot compared to that in buffer stage, from the perspective of physiology, the gastronomies muscle plays a crucial role in the kicking phrase, the process of kicking is the process that knee flexion angle becomes large from small, which is due to centripetal contraction of quadriceps, gastronomies and gluteus maximums. So strength training of gastronomies should be paid more attention in volleyball stop-jump.

Research on effect knee joint damage makes on stop-jump effect in volleyball sport

TABLE 6 shows a measure analysis on bend and stretch, adduction, internal and external rotation and the biggest flexion angle of lower limb hip joint, knee joint and ankle joint, so as to explore the effect knee joint damage makes on stop-jump effect.

As is shown in TABLE 7, in the landing buffer stage when volleyball athletes completed stop-jump and spike action, when the counterforce ground exerts to left and right legs reaches the biggest, the angle and biggest flexion angle conditions of hip joint, knee joint and ankle joint are as above. The test result aims at the four groups being researched in TABLE 6.

From the data in TABLE 7, we know female jumpers' double-knee damage's kicking moment of force is obviously greater than that of single-knee damage's, hence, bilateral knee damage's knee kicking moment of force significantly increases, making up the deficit of another leg. While members of unilateral knee damage will increase the moment of force of another leg in order to decrease the damaged leg's stress and load, realizing initiative make-up for damage side. Cang Hai (2012) pointed out the unbalance between body and power generation of lower limb muscle and knee joint damage may lead to the enlargement of hip joint's run-

TABLE 7: Volleyball athletes completed stop-jump and spike action the landing buffer stage

Classification	angle	men with unilateral knee damage		Men without damage		women with unilateral knee damage		women with bilateral knee damage	
		Right leg	Left leg	Right leg	Left leg	Right leg	Left leg	Right leg	Left leg
hip joint	1	-39.4±8.21	-38.6±6.90	-31.7±11.9	-32.6±12.1	-36.4±12.5	-43.1±9.21	-43.3±6.4	-35.4±15
	2	0.7±4.52	5.3±2.91	-1.6±6.92	-1.41±5.32	1.2±3.91	0.9±6.62	6.1±7.62	3.67±4.22
	3	-1.9±7.13	-2.9±7.92	-1.8±9.64	0.08±9.51	4.0±11.12	3.7±14.11	5.5±14.53	2.6±8.51
	4	-48.3±7.21	-48.7±7.91	-42.8±15.8	-54.2±40.3	-51.0±16.2	-55.8±15.2	-57.4±12	-51.3±16
knee joint	1	30.4±3.52	28.2±9.74	26.5±8.01	27.4±6.72	28.5±9.31	35.3±9.90	32.7±9.71	37.0±18.8
	2	-0.3±2.94	0.9±3.81	-0.1±2.92	-0.9±3.44	-3.09±5.82	-1.4±2.21	0.02±3.32	-0.6±2.82
	3	-8.8±8.60	-7.9±2.50	-2.7±6.93	-3.43±5.81	-6.8±9.14	-3.33±4.72	-4.8±5.01	-2.58±7.9
	4	74.1±7.42	74.8±7.41	74.4±12.04	73.5±9.80	75.1±9.81	72.21±11.8	71.4±12.1	74.67±9.9
Ankle	1	-0.7±13.50	-2.03±12.4	6.6±13.91	11.32±15.8	0.5±14.42	5.2±10.91	3.4±7.12	2.0±16.22
	2	-2.1±2.42	-1.8±1.12	2.2±3.61	3.3±3.62	1.6±3.71	1.7±3.22	1.8±1.80	1.4±3.42
	3	5.5±10.41	5.1±4.92	2.4±5.52	0.2±6.32	2.8±6.32	2.4±5.71	3.1±4.62	-0.6±4.52
	4	-11.3±65.9	-13.6±4.60	-1.36±4.93	-13.5±4.23	-14.7±6.20	-11.4±4.40	-9.3±6.61	-15.8±5.2

Note: 1 indicates flexion angle; 2 represents adduction, abduction angle; 3 indicates internal rotation, external rotation angle; 4 represents the maximum flexion angle

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ning torque. In the course of the completion of landing buffer, lower limb joints showed passive flexion, the female's bilateral and unilateral knee joint damage differ from the male's outward torque of injury group and no injury group. The injury group mainly increase outward torque of knee joint to make up the action of kicking, the knee joint torque is insufficient to serve as step length after injury, and when outward torque increases, it will make the ankle joint produce different degrees of values or plantar flexion.

CONCLUSION

This text firstly analyzed the characteristics of run-up, stop-jump and stroke with arm in volleyball spike action, focusing on the whipping effect when body transfers momentum from the distal end of big mass to stroke point proximal of small mass in the process of stroke with arm, which provides guidance for dynamic and biomechanical analysis of spike techniques in volleyball sport. Then, from the gravity kinetic parameters analysis of one-leg or double-leg take-off in spike, it concluded that athletes should keep the stability of body weight, and it is more scientific to have one-leg take-off at the proximal and have double-leg take-off at the distal end, which provided theoretical basis for take-off norms in volleyball spike. Next, it analyzed the angles variation of lower limbs joint in stop-jump of volleyball spike techniques on the application of biomechanical principles, Providing theoretical basis for the scientific planning of each joint's power generation order in stop-jump. After analyzing the eight major muscles' EMG features, conclusion was drawn that strength training of small muscles and gastronomies should be attached importance to in volleyball take-off training. Lastly, through the methods of group experiment and analyzing experiment data, this text explored the characteristics of biomechanical parameters of lower limbs joint, of athletes who suffer knee joint damage in the process of stop-jump, spike and landing. So conclusion was drew that knee joint damage based on angle analysis has influence on the stage of buffer and kicking off the ground in stop-jump, which provides referential suggestions for minimizing athletes' athletic injuries.

REFERENCE

[1] Yang Chun-Xia; Body Centre of Gravity Kinematics Characteristic Analyses of Volleyball Take-off in One-leg and Double-leg[J]. Journal of Shaanxi Institute of Education, **2**, 60-64 **(2013)**.

[2] Wang Yan-Li, Zhao Yan-Cheng, Jiang Bao-Hua, Wang Jian; Research on Relations between Muscle Strength of Trampolin Athletes, Lower Limbs and Their Jumping Heights[J]. Journal of Beijing Sport University, **28(2)**, 197-199 **(2005)**.

[3] Zhang Haibin, Ge Chunlin, Wang Feng; Analysis of Biomechanics in the Link of Scram and Jumping for the Volleyball Players[J]. Journal of Tianjin Institute of Physical Education, **28(5)**, 440-443 **(2013)**.

[4] Zhang Qing-hua, Hua Li-jun, Chen-Gang; Lunge-Smash and Takeoff Skill of Male Volleyball Players: An Analysis from the Perspective of Kinematics[J]. Sports Sciences Researches, **12(2)**, 65-67 **(2008)**.

[5] Wang Kun, Wang Hui, Liu Xiu-Feng, Song Hai-Si; The Biomechanical Analysis on Takeoff Technique between Chinese Female Jumper and World Elite Jumper in High Jump[J]. China Sport Science and Technology, **36(5)**, **(2000)**.

[6] Hua Li-Jun, Song Ji-Rui; Comprehensive study of the characteristics of jumping up for a volleyball smash and dedicated power[J]. Journal of Physical Education, **17(6)**, **(2010)**.

[7] Liu Shu-Zhi, Wu Ying, Li Yu-Zhang; On Features of Muscle Exertion of Some Chinese Elite Male Long-Jumpers during Take-Off Phrase[J]. Journal of Shanghai Physical Education Institute, **35(2)**, **(2011)**.

[8] Long Yue, Yu et al; Study on the Takeoff Leg's Capacity of Stretching-Shortening Cycle in Male Triple Jumpers[J]. China Sport Science, **21(1)**, 79-83 **(2001)**.