Biomechanics of Running State Protection of the Measurement and Evaluation System

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Abstract

With the more and more high enthusiasm of people participating in sports, the corresponding joint, muscle and ligament are often repeatedly stretched and extruding damage and frequent. In this paper, the seriousness of the injury was reviewed, respectively from the sports biomechanics and protective equipment, the research status of two aspects of analysis protective clothing based on the importance of sports biomechanics research protective clothing, and put forward the application of the sports biomechanics in the field of clothing, the theoretical basis of the technical problems and technical route, In order to establish a movement measurement and evaluation system based on biomechanical to provide theoretical basis.

Keywords: Protective clothing, Sports biomechanics, Protection model, Muscle, Evaluation system

1. Introduction

With the increase of motivated people, exercise population increased greatly. In the process of exercise, because people didn't pay attention to protect our too much, often can cause the corresponding joints, muscles, ligaments accidental damage. Often leads to tennis elbow, rotator cuff injury, van Kramer (Van Kramer) in the investigation have been carried out to damage arising from the tennis, (Lei Zhang, Shaohua Wang, 1995) the results showed that in the tennis elbow injury accounted for 41% of all damage, is the most easy to damage the parts; Rotator cuff injury accounted for 39% of their total damage, after tennis elbow. In the running, often happen crus muscle of lower limb, studies have found that up to 35% ~ 65% of exercisers and professional athletes has been lower limb injury. (Wei Wang, 2011)

Muscle damage, especially the chronic muscle strain in sports, the ministry of labour and the muscular activity of daily life and so on are all more common. According to reports in the literature, the sports injury of the excellent athletes muscle damage is more than 50%. (LU Dinghou, 2006) In labor and daily life, muscle damage are also more common. The elderly are prone to muscle strain is attributed to gradually reduce along with the age growth if muscle activity, the structure and function of muscle will be weakened gradually led to the decrease of the ability to work, and therefore easy to excessive load caused by muscle damage.

This paper introduces the application in the field of clothing, sports biomechanics sports biomechanics and sports protective equipment, as well as the current research status of protective clothing and protective measurement and evaluation system of sports biomechanics, etc.

2. The present situation of the application of sports biomechanics in garment field

Sports biomechanics is the study of human mechanical motion law of sports science. (Jinyue Wang, WeiLiu, Minsheng, 2003) Sports biomechanics is to use biology and mechanics theories and methods to study the human body is engaged in various kinds of sports, activities and labor movement technology, make the complex human motion technology based on the basic rule of biology and mechanics, and in mathematics, mechanics, biology as well as technical principle in the form of a movement to quantitative description. (Xiangdong wang, Xuezhen Liu, TingGang Yuan, De'ming Lu, 2003) Development and research of sports biomechanics, for raising the grade of the sports, sports injury prevention, thus laid a foundation for the design research and development of protective

equipment.

2.1 The application of sports biomechanics

From the viewpoint of sports injury prevention, for a variety of sports biomechanics analysis, activities and productive labor, find out the factors and design the corresponding prevention and treatment measures. In competitive sports movement technology, according to the human body posture, quality, function, and so on and so forth, study of sports and activities of best personal technology action plan, and make diagnosis through action technology gradually improve. Not only sports biomechanics research human body, and also the movement rule of research related to sports equipment. According to the biomechanics of human body shape, structure and function characteristics, design and improve the sports equipment, facilities, clothing and gear machines, tools and labor.

2.2 The sports biomechanics and The Sports protective equipment

For sports and fitness exercise protection of personal safety and avoid sports injury of the equipment, this paper puts forward the ideas of design and improvements and requirements, based on the current development of sports biomechanics protection articles mainly include gear, sneakers.

In the process of movement, the human body each joint muscle often due to too much exercise, or the moment of swing, tensile strain or injury. After wearing protective devices, can for the corresponding muscle, ligament pressure, slow may overstretch, and help the muscle action, to support your joints. For joint appear different degree of strain old people and children are puberty, go hiking outing or physical exercise, it is necessary to select some protective devices.

A line of sports brand at home and abroad, its sports shoes technology every progress, cannot leave the biomechanics research, structure design and technological innovation all follow the principle of biomechanics. (Jianshe Li, Yaodong Gu, Yichen Lu, 2009) In the Nike brand shoes are specifically designed for tennis shoe money, its product in the as geometric embossed polo shirt mesh design, adopted the shoulder with Nike dri fit technology, provide top breathable performance for athletes, ZOOM VAPOR 9 TOUR LEA men's tennis shoes to ultimate lightweight performance speed type tennis player the best partner. Using adaptive joint in package design, can cast light texture for athletes and comfortable support, let you get more stable and smooth, when high-speed mobile flexible gait advantage, the combination of the ball and heel ZOOM air cushion can creat for feet high response protection, make the athletes of the reversing or smooth start-up speed is faster.

3. The research status of protective clothing

Traditional protective clothing is basically from the comfort, structure design, functional materials, such as Angle to carry on the design research, through the study of performance to achieve change or improve the fabric clothing breathable, moisture absorption perspiration waterproof effect, such as fire or from clothing structure design, adopt more open loose type design, in the chest, armpits, pieces before and after the continuous opening heat dissipation function design, design a set of heat dissipation function of basketball match clothing. (Suhua Zheng, Xin Zhang, 2008)

At this stage on the basis of sports biomechanics research and sports protective gear only sneakers, and customer demand for protective clothing has gradually from the original comfort aspects, such as moisture absorption perspiration to protective integration, function, beautiful, comfortable, more hope can through the clothing itself can achieve the purpose of protection of human body.

4. Protective measurement and evaluation system of sports biomechanics

Physical exercise, daily activities and productive labor in bone and muscle damage is difficult to avoid problems, solve this problem, it must take human movement as the goal, the use of human anatomy, human physiology, mechanics theories and methods to explore the human body motion, (Beumer A. van Hemert WL, Swierstra BA. et al, 2008) according to the change of the bones and muscles, external protection model is set up, get protective clothing required to achieve mechanical parameters, protective clothing to provide theory basis for the development of movement.

4.1 Scientific theory research

Muscle function model researches more mature, and is to determine the length of the muscle, muscle, arm muscle strength, muscle tension line moment, muscle and other key factors, (Damao Shan, 2005) but there is no clear bone and muscle damage threshold, outer protective model is the key to solve the problem.Based on the dynamic model of human bones and muscles, simulation in external constraint conditions, the change of the bones and muscles, through the reverse dynamic equation and finite element simulation for related parameters, establish outer protective

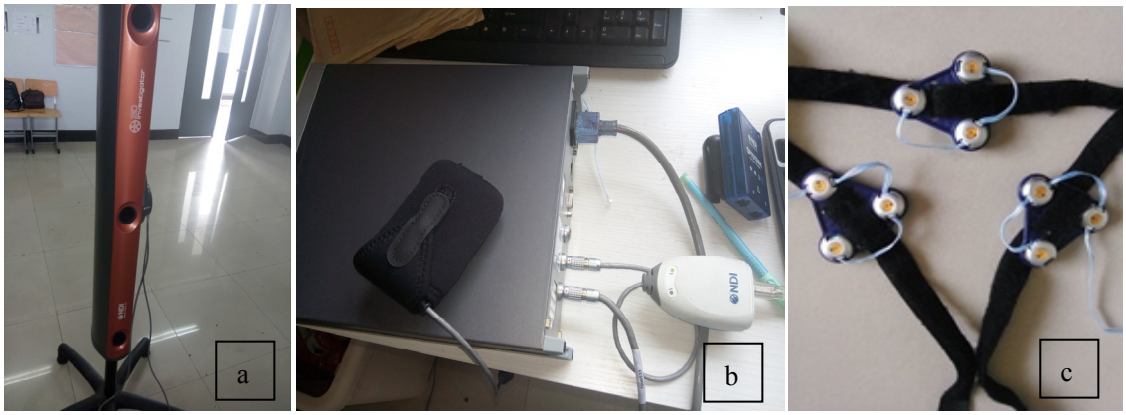
mechanism, namely protection model;Under plus reaction experiment, the performance and outer protective clothing material model, the relationship between the developed for high quality sports protective clothing, reduce movement in the process of bone and muscle damage, and provide theoretical basis.

By measuring the human body each joint point movement of the change of the three-dimensional coordinate data, converting it into biomechanical parameters of human joint movement, through the analysis of biomechanics parameter data, physical protection model is set up, clear fabric and protection model of the relationship between each other, and connecting with the clothing material, clothing structure design, human ergonomics and other related knowledge, design with protective.

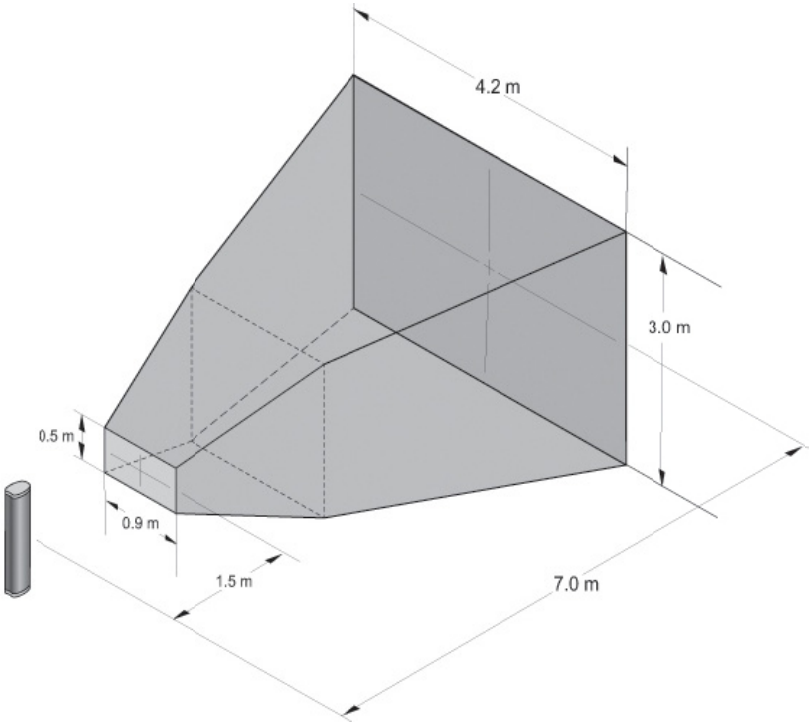
4.2 Measurement of sports biomechanics

By measuring the human body each joint point movement of the change of the three-dimensional coordinate data, converting it into biomechanical parameters of human joint movement, through the analysis of biomechanics parameter data, physical protection model is set up, clear fabric and protection model of the relationship between each other, and connecting with the clothing material, clothing structure design, human ergonomics and other related knowledge, design with protective clothing.

Set up the Bone and muscle model; Capture the key points of space by NDI;



Picture 1. Motion measurement system: position sensor; b. the central control unit; c. marker point



Picture 2. The scope of the capture system dynamic measurement

Through the EMG muscle signal equipment to detect movement condition; Using the EMG detection when the click of a mouse refers to the average power of the extensor frequency spectrum and the median frequency changing with time series show monotone decreasing trend, showing good reflects the sensitivity of fatigue. (Le-jun wang, Liu Aiyun etc, 2013) In the process of muscle fatigue, biggest contraction force fell by 50% in the center of the corresponding frequency decline curve are sensitive to fatigue, a more accurate representation of the level of fatigue. (Wei er Wen, wei-yi Chen, 2007)

EMG spectral change and the relationship of H +, biceps in MVC static at 60% State in the process of fatigue load MPF linear decrease. Recovery after fatigue load After a period of MPF recover very quickly, and the end of the only 2 s, MPF has been restored to the whole26.5% of the range;To 30 s, MPF has returned to the decline range 87.7%. (Wei er Wen, wei-yi Chen, 2007)

With the help of the human body modeling simulation software, the space trajectory data into biomechanical parameters, such as displacement, velocity and acceleration of each joint, muscle length, arm muscle strength, muscle torque, etc., and then calculate the human body protection parameters; Based on bone and muscle model, by using the method of inverse dynamics to establish human body external protection mechanism; According to the performance of all kinds of clothing materials, through the finite element simulation, determine the material performance and protection model of the relationship between each other, get protective clothing required protective parameters; The human body modeling and simulation software for simulating clothing protection parameters can be obtained, and further to obtain the optimal protective clothing;

4.3 The evaluation system of sports biomechanics

This experiment subjective selection questionnaire to evaluate three kinds of subjective feeling, are: sports protective pants oppressive feeling, convenience, running local muscle fatigue.

Set a subject in the experiments, the setting of the running time of 120 minutes, according to jogging speed of 5 km/h, which every 15 minutes, rest for 2-3 minutes, and rapidly change different protective effect of sweatpants, to ensure that each protective pants have enough stress recovery time, so at the same time the tester to the participants subjective questions, evaluate the subjective feeling of sweatpants evaluation factors, the process need cycle is repeated eight times.

Based on the subjective appraisal standard is in accordance with the five period of, (Wang Yunyi, Wang Xiaoqiong, 2007) the evaluation method for garment comfort evaluation of subjective scale as reference model designed for the protective clothing sports subjective scale of performance evaluation, required subjects between numerical [-2, 2], from worse to better to wear the subjective feeling of scores.

5. Summary

In the process of movement, the muscle and bone often accident damage. the Traditional protective clothing, basically from the perspective of clothing comfort, either by changing the characteristics of the fabric to clothing, wet gas, such as moisture absorption perspiration, or from the structural design of clothing, change clothes under clearance, opening characteristics to improve clothing clothing comfort. (Xianghui Zhang, Jun Li, Yunyi Wang, 2009) Abroad on the study of sports protective clothing and equipment is more thorough, the from head to foot of each organs have certain protective appliance, so protective clothing will be based on sports biomechanics research is popular in the future research.

Establishing sports under the state protection model especially musculoskeletal protection model is very necessary. Protective model is a key in the field of sports biomechanics is applied to clothing, is also the main factor of restricting the protective clothing research and development. Protection model in the initial stage, only to establish protection model, to further clarify the relationship between mechanical parameters and protection of clothing materials, and to reduce the sports injuries of sports equipment technical basis.

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