Molecular & Cellular Biomechanics

Tech Science Press

DOI: 10.32604/mcb.2023.044564

EDITORIAL

Hot Topics of Molecular and Cellular Biomechanics in 2022

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Received: 02 August 2023 Accepted: 09 August 2023 Published: 29 September 2023

ABSTRACT

The analysis of biomechanical characteristics plays an important role in mastering the technical characteristics of athletes, providing guidance for the formulation and prevention of sports injury training plans and providing theoretical support for research on injury prevention and stability control in the sports field. With the importance of data analysis, the application scope of artificial intelligence methods is more extensive. For example, intelligent training systems can be used for athletes' personalized and professional training, real-time monitoring and feedback of training data, and further reduce the risk of sports injury. However, deep learning methods process a large number of medical images to identify and predict diseases such as cancer.

KEYWORDS

Hot topics; biomechanics; sport; artificial intelligence; deep learning

In 2022, Molecular and Cellular Biomechanics (MCB) published a total of 20 articles, of which 50% were based on research on various sports biomechanics, providing reasonable suggestions for athlete training. The other part is based on cell mechanics to diagnose and treat cancer, such as distinguishing hemophilia, diagnosing lung cancer and treating breast cancer. Based on computational fluid analysis, including the shear stress of coronary vessels of COVID-19 patients, arteriovenous fistulas, fetal umbilical cord, etc. According to the biomechanical and biological results, collagen/CMC hydrogel can be used as a suitable substitute filler for skin tissue engineering.

In sports, how to improve athletes' technical level, increase their chances of winning, and reduce injuries caused by sports is the focus of attention for athletes and coaches. Biomechanics has been widely used in various sports research, not only as an analysis of sports training but also as a guide to sports injury and injury prevention. Based on the biomechanical analysis of men's badminton players' legs when landing on one leg, in the training process, athletes should strengthen the stability training of both legs, especially the left leg, to reduce sports injury [1]. High-level football players should pay attention to the speed and strength of their kicks during training. They can achieve high-quality kicks by increasing the swing and speed of their kicks to improve their kicking skills [2]. Establishing a musculoskeletal model using

OpenSim software to investigate muscle strength can provide guidance for motion control and injury prevention in table tennis footwork [3].

Core strength training is a more targeted exercise for the trunk core area composed of the waist, pelvis, hip joint and its muscle group than traditional strength training, which can improve the power transfer between the upper and lower limbs and the balance of trunk movement. For basketball players, the hit rate of fixed point field goal percentage and dribbling jump shot have significantly improved [4]. The improvement effect of core strength strengthening training on lumbar spine injury provides a theoretical basis for reducing and improving athlete lumbar spine injury [5]. Strengthening lower limb muscles is very important for balancing the joint strength of Latin dancers and preventing foot injuries [6]. Research has shown that forefoot shoes can also be used to treat patients with knee joint injury and dysfunction [7]. Wearability, intelligence, digital, and fast feedback have become essential basic requirements for current training devices. Wang et al. [8] showed that a full-dimensional servo-driven intelligent training system can significantly improve the quality index of the special technical strength of quasi seat cross-country pair skiing and enhance the special ability on snow. Maintaining or increasing skeletal muscle mass is important for many athletes, and supplementing spirulina can enhance muscle growth during resistance training [9]. The methods of nutritional supplementation and sports training have a significant impact on improving the physical fitness of track and field athletes, enhancing limb flexibility and stability, and having a positive impact on physical fitness [10].

Cells constantly adapt to the environment and stimuli they receive (i.e., chemical, electrical, mechanical, etc.). They can experience larger strains in the limited migration process through subcellular or subnuclear pores. Allena et al. [11] proposed a two-dimensional silicon model that simulates the first three steps of interaction between cells and the microcylinder substrate (i.e., contact, adhesion, and diffusion), quantifying the distribution of stress and strain in the nucleus, which may be the cause of specific phenomena such as fiber layer rupture or stretch-sensitive protein expression, and providing insights into the mechanism of inducing nuclear deformation. Some cells, such as cancer cells, can even undergo nuclear layer rupture and migrate in healthy tissues. For example, leukemia is a type of canceration that usually originates from bone marrow and leads to a large number of abnormal white blood cells (WBCs). However, leukocytosis is common in leukemia and leukemoid, so doctors may misdiagnose patients with leukemoid reactions as malignant leukemia. Sriram et al. [12] proposed a deep learning technology based on the VGG16 convolutional neural network architecture, which is being used to classify and count WBC types from segmented images. The proposed methods for white blood cell classification, counting, and mother cell classification can be used to accurately diagnose leukemia and leukemia-like reactions and support doctors in proposing appropriate treatment methods for patients.

The early symptoms of lung tumors usually manifest as nodules on CT scans. With the increasing popularity of cancer, a large number of CT images waiting for diagnosis have brought a huge burden to doctors. Doctors may miss or misdetect abnormalities due to fatigue. Bu et al. [13] proposed a new lung nodule detection method based on the YOLOv3 deep learning algorithm. Using the Poisson image editing algorithm to generate a dataset can reduce the need for original training data and improve training efficiency. Using therapeutic peptides to specifically target and destroy cancer cells has attracted extensive attention. It takes time to identify and predict potential anticancer peptides using computational biology methods. Suryawanshi et al. [14] selected 20 polypeptide sequences for 3D modeling and molecular docking analysis of anti-breast cancer. *Curcuma longa* predicted peptide sequence docked with breast cancer receptor, and macromolecular docking technology was used to evaluate the binding affinity of expected peptide with MHC molecule.

COVID-19-infected patients are at high risk of thrombotic arterial and venous occlusion. Changes in blood viscosity caused by infection cause considerable changes in blood flow parameters such as velocity,

pressure and wall shear stress. Therefore, the novel coronavirus has a serious impact on hematology parameters [15]. Arteriovenous Fistula (AVF) is a recognized vascular pathway method in hemodialysis for end-stage renal disease. Shembekar et al. [16] created three-dimensional ideal geometric structures for four different fitting angles of end side AVFs. Studying the impact of the anastomosis angle on WSS, pressure drop, and venous outflow rate and determining the optimal anastomosis angle for AVF can help standardize surgical techniques. The umbilical cord is an important structure between the fetus and the placenta and is vital to the growth and health of the fetus. Song et al. [17] discussed the morphological metrology characteristics and arterial blood flow parameters of the umbilical cord under normal and pathological conditions. Accurately understanding the impact of umbilical cord abnormalities and blood flow will lead to more accurate clinical diagnosis and treatment, ultimately protecting the health of mothers and infants, and is crucial for the continuation of humanity.

Due to the reduction in collagen and fat in the dermis caused by aging, trauma, and disease, it is widely needed as an injection filler for soft tissue enhancement. Samanipour et al. [18] prepared an injectable soft tissue filler containing human acellular collagen and carboxymethyl cellulose (CMC). According to the provided biomechanical and biological results, it can be claimed that collagen/CMC hydrogel is a suitable alternative filler for skin tissue engineering. Myopia is a common ophthalmic defect. The structure and function of Tapetum lucidum are considered to be related to myopia. Qin et al. [19] showed that the thickness of the choroidal layer in myopia is significantly thinner than that in normal eyes. The application of spectral-domain OCT to the comprehensive evaluation of the thickness of myopia and normal choroid can provide an important reference for the development of medical methods for the diagnosis and treatment of myopia. Threading a thread through the eye of a needle is a very common problem in daily life. The mechanism of thread passing through the needle eye is very similar to the mechanism of a series of polymer chains passing through synthetic macrocycles in biological science. Song et al. [20] proposed a new friction method for passing through the needle eye and discussed its potential applications in simulating microassembly processes in the fields of biomechanics and mechanical biology.

According to the literature review, the hot topics in biomechanics research are becoming increasingly closely related to our daily lives, which will be an important development direction in biomechanics.

Acknowledgement: This work was supported by grants from the National Natural Science Foundation of China (12032007, 31971242) and the Science and Technology Innovation Project of Jinfeng Laboratory, Chongqing, China (jfkyjf202203001). The authors also thank Dr. Longling Fan of Yunnan Normal University and Professor Chaojun Tang of Soochow University for their valuable suggestions on the writing and revision of this article. The authors are also thankful for the First Batch of Key Disciplines on Public Health in Chongqing and the Public Experiment Center of State Bioindustrial Base (Chongqing), China.

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