

# 应用生物力学

YIYONG SHENGWU LIXUE

双月刊 1986年6月创刊 第39卷 第4期 2024年8月出版



[期刊基本参数] CN 31-1624/R \* 1986 \* b \* A4 \* 224 \* zh+en \* P \* ¥25.00 \* 2000 \* 30 \* 2024-08

主管  
中华人民共和国教育部  
主办  
上海交通大学  
承办  
上海交通大学医学院附属  
第九人民医院  
出版  
《医用生物力学》编辑部  
编辑部  
地址 上海市制造局路 639 号  
邮编 200011  
电话 (021) 53315397  
传真 (021) 63137020  
电子邮件  
shengwulixue@163.com

网址  
<http://www.medbiomechanics.com>  
<http://www.mechanobiology.cn>  
微博  
<http://weibo.com/u/2040064195>  
广告部 水汶

名誉主编  
戴尅戎  
主编  
姜宗来  
执行主编  
赵杰  
常务副主编  
陈维毅 樊瑜波 冯西桥 郭向东  
秦岭 张西正

副主编  
房兵 刘有军 杨慧 王向阳  
蒲放 顾耀东 刘卉 于志锋  
编辑部主任  
于志锋  
E-mail: zfyu@outlook.com

责任编辑  
徐绮  
E-mail: 1534340082@qq.com

英文编辑  
徐绮

编辑  
《医用生物力学》编辑委员会  
印刷  
山西同方知网印刷有限公司

国内发行  
上海市报刊发行局

国外总发行  
中国国际图书贸易总公司

订购  
全国各地邮局  
邮发代号 4-633

定价  
每期:25.00元 全年 150.00元  
国内统一连续出版物号  
CN 31-1624/R

国际标准连续出版物号  
ISSN 1004-7220

CODEN YSLIBU  
©2024 年版权归《医用生物力学》  
编辑部所有

## 目次

### 专家论坛

- 竞技体育生物力学 2023 年度研究进展 ..... (563)  
李上校, 杨进, 郝卫亚  
巴黎奥运周期竞技游泳运动生物力学研究进展 ..... (576)  
顾耀东, 汪顺, 徐异宁

### 论著

- 不同鞋面硬度对击球时足部应力和球运动的影响 ..... (586)  
王硕, 朱晓兰, 邓成  
基于因子回归分析研究影响棒球击球机械能的下肢生物力学  
因素 ..... (593)  
王世坤, 辛雷, 杨晨, 顾雪宋  
梯度流体剪应力下细胞膜张力的数值模拟 ..... (600)  
曹淑婷, 赵森, 张笑, 高颜, 霍波  
骨陷窝-小管结构改变对骨细胞流体动力学微环境的影响  
..... (607)  
王晨璐, 王慧茹, 杨海胜  
不同运动状态下胰岛素对 2 型糖尿病大鼠骨髓间充质干细胞分  
化的影响 ..... (615)  
武晓丹, 宫赫, 史佩佩, 胡小容  
miR-194-3p 调控模拟微重力条件下致成骨细胞功能异常的实验  
研究 ..... (623)  
薛进冬, 程路畅, 王敏, 谭彩美, 邓琪琪, 朱海美, 郭勇, 韩标  
皮质骨微观能量释放率与大鼠月龄关系 ..... (631)  
黄丽萍, 王溢童, 胡辰, 吴华杰, 贾政斌, 范若寻  
UKA 胫骨托盘背部设计对骨-假体固定界面的生物力学影响  
..... (637)  
马张稳, 张兵, 薛敏, 董天琦, 张静, 陈项贤  
术中塑形与锁钉分布及术后愈合状态对接骨板生物力学的影响  
..... (644)  
周望, 徐剑晴, 何思渊, 张述, 王俊文, 焦竞, 米博斌, 刘国辉,  
朱威威, 何智圣, 张柳云, 刘梦星  
利用克氏针治疗儿童股骨远端骨骺损伤的有限元分析  
..... (651)  
王晓明, 王晓威, 白桓安, 杨亚婷, 顿强  
基于有限元数据集建立髌臼周围截骨术的骨刀变形预测模型  
..... (657)  
李玉梅, 韩阳, 卢鼎  
全膝关节置换术对膝骨关节炎患者本体感觉的影响 ..... (663)  
张权, 石静楠, 张宽, 张昊华, 闫松华

单间室与全膝关节置换术对膝骨关节炎患者楼梯行走时生物力学特征的影响 .....	(670)
曹传宝, 史东林, 柴光伟, 王鑫, 张艳红, 马刚, 闫士芳	
肌肉电刺激联合肌力训练对髌股关节痛患者膝关节生物力学特征的影响 .....	(677)
姚英策, 赵建斌, 杨晓巍, 吴菁, 薛博士, 王霞, 杨辰, 郑亮亮, 周志鹏	
双叶机械瓣膜不同植入角度对主动脉血流动力学的影响 .....	(685)
刘晶鑫, 邓小燕, 敖海勇, 张全超	
保留瓣膜两种主动脉根部置换术的生物力学数值模拟 .....	(691)
王倩, 罗新锦, 丘俊涛, 胡圣懿, 丁学超, 杜田明, 张艳萍, 侯倩文, 乔爱科	
基于双向流固耦合分析载瘤对颈动脉血管发展及影响 .....	(699)
冉鹏, 张焜林, 李闽氘	
一种基于多普勒超声与神经网络的脑缺血风险评估方法 .....	(706)
曾泽延, 余龙, 秦旺, 汪昕, 丁晶, 王盛章	
基于体外实验的光电容积脉搏波信号检测及脉率特性 .....	(712)
何卫俊, 刘雍陶, 刘登吉, 尹凯, 贺纓, 迟青卓, 母立众	
冲击力作用下种植体周围骨动态力学响应的数值模拟 .....	(718)
马新扬, 刁晓鸥, 侯兵, 王丹杨	
预制裂纹的预备后椭圆形根管牙根有限元模型构建及分析 .....	(724)
陈词, 王通, 李慧影, 付静, 郭婧涵, 许海平	
轻度创伤型大鼠颅脑前后向-侧向碰撞 HIC 值等效研究 .....	(730)
王国祥, 朱林娜, 王讯, 陈秋菊, 熊涛, 罗庆航, 于佳, 许竞毓, 尹志勇, 刘盛雄	
阴道分娩对猪子宫韧带力学性能的影响 .....	(736)
王丽丽, 刘然	
角膜塑形镜几何设计参数对角膜生物力学影响的有限元研究 .....	(742)
吴丽敏, 赵改平, 张泽众, 项华中, 陈齐欧, 陈炽	
无创气道正压通气下呼气末测算气道阻力和肺顺应性实验研究 .....	(750)
袁越阳, 解立新, 陈宇清, 胡兴硕, 黄皓轩, 李立雄, 徐强	

## 综 述

软组织再生力医学 .....	(756)
师念园, 马玉菲, 徐峰	
颈前路手术治疗颈椎病的有限元研究进展 .....	(768)
田雪丰, 吕俊桥, 尉哲铭, 刘阳, 孙麟	
力学刺激在破骨细胞分化中的作用 .....	(775)
王涵, 于志锋	

## 书 讯

运动生物力学在体育教育中的应用 .....	(783)
王华	
篮球运动中膝关节损伤与防治 .....	(784)
辛阳	
生物力学视角下骨科患者手术的护理干预 .....	(785)
刁青花, 孙梅华, 沙珍萍	
基于生物力学的运动技术优化探索 .....	(786)
李孟皓, 张良	

《医用生物力学》杂志由中华人民共和国教育部主管、上海交通大学主办, 所发表之图文、版权(含翻译权)均归《医用生物力学》编辑部(出版人)所有。未经出版人书面许可, 不得对本刊内容进行任何目的和形式的转载、转播及复制, 包括转换成用于资料信息处理设施的机械、电子语言。

本刊实行通讯作者负责制, 每篇论文均由 2~3 位同行评委(peer reviewer)独立审稿。发表的图文中所表达的任何内容与观点, 均属作者个人的见解与意见, 并不反映和代表《医用生物力学》编辑部的立场和观点。有关所发表文章的任何问题, 均由作者负责解释, 出版人不承担任何与之相关的责任。

本刊是中国科技核心期刊, 已被北京大学图书馆《中文核心期刊要目总览》、《中国科学引文数据库》、荷兰《文摘与引文数据库》等国内外多家知名数据库收录。

本杂志采用无酸纸(acid-free)印刷。

# JOURNAL OF MEDICAL BIOMECHANICS

Published Bimonthly

Founded in June, 1986

Volume 39 Number 4, Aug. 2024

[ Journal Basic Information ] CN 31-1624/R \* 1986 \* b \* A4 \* 224 \* zh+en \* P \* ¥25.00 \* 2000 \* 30 \* 2024-08

## Supervised by

Ministry of Education of  
the People's Republic of China

## Sponsored by

Shanghai Jiao Tong University

## Organized by

Shanghai Ninth People's Hospital,  
Shanghai Jiao Tong University  
School of Medicine

## Published by

Editorial Office of  
*Journal of Medical Biomechanics*

## Editorial Office

No. 639 Zhizaoju Rd.,  
Shanghai 200011, China  
Tel: + 86 21 53315397  
Fax: + 86 21 63137020  
E-mail: shengwulixue@163.com  
Website:

<http://www.medbiomechanics.com>

<http://www.mechanobiology.cn>

## Microblog:

<http://weibo.com/u/2040064195>

Advertising division: SHUI Wen

## Honorary Editor-in-Chief

DAI Kerong

## Editor-in-Chief

JIANG Zonglai

## Executive Editor-in-Chief

ZHAO Jie

## Executive Vice Editor-in-Chief

CHEN Weiyi FAN Yubo  
FENG Xiqiao GUO Xiangdong  
QIN Ling ZHANG Xizheng

## Associate Editors-in-Chief

FANG Bing LIU Youjun  
YANG Hui WANG Xiangyang  
PU Fang GU Yaodong  
LIU Hui YU Zhifeng

## Editorial Director

YU Zhifeng  
E-mail: zfyu@outlook.com

## Editor-in-charge

XU Qi  
E-mail: 1534340082@qq.com

## English Editor

XU Qi

## Edited by

Editorial Board of  
*Journal of Medical Biomechanics*

## Printed by

Shanxi Tongfang Knowledge Network Printing  
Co., Ltd.

## Overseas Distributor

China International Book  
Trading Cooperation

## China Standard Serial Numbering

ISSN 1004-7220  
CN 31-1624/R  
CODEN YSLIBU

## Subscription

Yearly Subscription Rates: 150.00 RMB  
Single Issue: 25.00 RMB

Copyright © 2024 by the Editorial

Board of *Journal of Medical Biomechanics*

## Contents

### Expert Forum

Research Progress of Competitive Sports Biomechanics in 2023  
..... (563)

*LI Shangxiao, YANG Jin, HAO Weiya*

Research Progress of Competitive Swimming Sport Biomechanics During  
Paris Olympic Games Period ..... (576)

*GU Yaodong, WANG Shun, XU Yining*

### Original Articles

Effects of Different Shoe Stiffness on Foot Stress and Ball Motion During  
Kicking ..... (586)

*WANG Shuo, ZHU Xiaolan, DENG Cheng*

Biomechanical Factors of Lower Limbs Affecting Mechanical Energy of  
Baseball Batting Based on Factorial Regression Analysis ..... (593)

*WANG Shikun, XIN Lei, YANG Chen, GU Xuesong*

Numerical Simulation of Cell Membrane Tension under Gradient Fluid  
Shear Stress ..... (600)

*CAO Shuting, ZHAO Sen, ZHANG Xiao, GAO Yan, HUO Bo*

Effects of Changes in Osteocytic Lacunar-Canalicular System Architecture  
on Fluid Dynamic Microenvironment of Osteocytes ..... (607)

*WANG Chenlu, WANG Huiru, YANG Haisheng*

Effects of Insulin on BMSCs Differentiation in Type 2 Diabetic Rats under  
Different Exercise Conditions ..... (615)

*WU Xiaodan, GONG He, SHI Peipei, HU Xiaorong*

MiR-194-3p Regulation of Simulated Microgravity Induced-Dysfunction of  
Osteoblasts: An Experimental Study ..... (623)

*XUE Jindong, CHENG Luchang, WANG Min, TAN Caimei, DENG Qiqi,  
ZHU Haimei, GUO Yong, HAN Biao*

Relation Between Micro-Level Energy Release Rate in the Cortical Bone  
and Rat Age ..... (631)

*HUANG Liping, WANG Yitong, HU Chen, WU Huajie, JIA Zhengbin,  
FAN Ruoxun*

Biomechanical Effects of the Backside Design of UKA Tibial Tray on the  
Bone-Prosthesis Fixation Interface ..... (637)

*MA Zhangwen, ZHANG Bing, XUE Min, DONG Tianqi, ZHANG Jing,  
CHEN Zhenxian*

Effect of Intraoperative Shaping, Screw Distribution, and Postoperative  
Healing on Plate Biomechanics ..... (644)

*ZHOU Wang, XU Jianqing, HE Siyuan, ZHANG Shu, WANG Junwen,  
JIAO Jing, MI Bobin, LIU Guohui, ZHU Weiwei, HE Zhisheng,  
ZHANG Liuyun, LIU Mengxing*

Finite Element Analysis of Kirschner Wire Treatment for SH-II Distal  
Femoral Fracture in Children ..... (651)

*WANG Xiaoming, WANG Xiaowei, BAI Huan'an, YANG Yating, JIE Qiang*

Predictive Modeling of Bone Knife Deformation in Periacetabular  
Osteotomy Based on Finite Element Dataset ..... (657)

*LI Yumei, HAN Yang, LU Ding*

Effects of Total Knee Arthroplasty on Proprioception in Patients with Knee  
Osteoarthritis ..... (663)

*ZHANG Quan, SHI Jingnan, ZHANG Kuan, ZHANG Haohua, YAN Songhua*

Effects of Unicompartmental and Total Knee Arthroplasty on the Biomechanical Characteristics of Patients with Knee Osteoarthritis During Stair Ascent and Descent .....	(670)
<i>CAO Chuanbao, SHI Donglin, CHAI Guangwei, WANG Xin, ZHANG Yanhong, MA Gang, YAN Shifang</i>	
Effects of Muscle Electrical Stimulation Combined with Muscle Strength Training on Biomechanical Characteristics of Knee Joint in Patients with Patellofemoral Pain .....	(677)
<i>YAO Yingce, ZHAO Jianbin, YANG Xiaowei, WU Jing, XUE Boshi, WANG Xia, YANG Chen, ZHENG Liangliang, ZHOU Zhipeng</i>	
Effects of Different Implantation Angles of Bi-Leaflet Mechanical Heart Valve on Hemodynamics in the Aorta .....	(685)
<i>LIU Jingxing, DENG Xiaoyan, AO Haiyong, ZHANG Quanchao</i>	
Numerical Simulation of Biomechanics of Two Aortic Root Replacement Procedures with Valve Preservation .....	(691)
<i>WANG Qian, LUO Xinjin, QIU Juntao, HU Shengyi, DING Xuechao, DU Tianming, ZHANG Yanping, HOU Qianwen, QIAO Aike</i>	
Analysis of Development and Influence of Parent Tumor on Carotid Artery Based on Two-Way Fluid-Structure Coupling Method .....	(699)
<i>RAN Peng, ZHANG Kunlin, LI Minchuan</i>	
A Cerebral Ischemia Risk Assessment Method Based on Doppler Ultrasound and Neural Network .....	(706)
<i>ZENG Zeyan, YU Long, QIN Wang, WANG Xin, DING Jing, WANG Shengzhang</i>	
Photoplethysmography Pulse Wave Signal Detection and Pulse Rate Characteristics Based on an <i>in vitro</i> Experiment .....	(712)
<i>HE Weijun, LIU Yongtao, LIU Dengji, YIN Kai, HE Ying, CHI Qingzhuo, MU Lizhong</i>	
Dynamic Mechanical Response of the Peri-Implant Bone Structure Subjected to Impact Load: A Numerical Study .....	(718)
<i>MA Xinyang, DIAO Xiaou, HOU Bing, WANG Danyang</i>	
Construction and Analysis of Finite Element Models for Oval Root Canals after Preparation with Micro-Crack .....	(724)
<i>CHEN Ci, WANG Tong, LI Huiying, FU Jing, GUO Jinghan, XU Haiping</i>	
HIC Value of Mild Traumatic Rats under Anterior-Posterior and Lateral-Medial Craniocerebral Impact: An Equivalent Study .....	(730)
<i>WANG Guoxiang, ZHU Linna, WANG Xun, CHEN Qiuju, XIONG Tao, LUO Qinghang, YU Jia, XU Jingyu, YIN Zhiyong, LIU Shengxiong</i>	
Effects on the Mechanical Properties of Uterine Ligaments in Porcines During Vaginal Delivery .....	(736)
<i>WANG Lili, LIU Ran</i>	
Influence of Orthokeratology Lens Geometric Design Parameters on Corneal Biomechanics: A Finite Element Study .....	(742)
<i>WU Limin, ZHAO Gaiping, ZHANG Zezhong, XIANG Huazhong, CHEN Qiou, CHEN Chi</i>	
Calculating Airway Resistance and Lung Compliance at Expiration End under Non-invasive Positive Pressure Ventilation: An Experimental Study .....	(750)
<i>YUAN Yueyang, XIE Lixin, CHEN Yuqing, HU Xingshuo, HUANG Haoxuan, LI Lixiong, XU Qiang</i>	
<b>Review Articles</b>	
Mechanomedicine for Soft Tissue Regeneration .....	(756)
<i>SHI Nianyuan, MA Yufei, XU Feng</i>	
Progress of Finite Element Study on Anterior Cervical Surgery for Cervical Spondylosis .....	(768)
<i>TIAN Xuefeng, LÜ Junqiao, YU Zheming, LIU Yang, SUN Lin</i>	
Role of Mechanical Stimulation in Osteoclast Differentiation .....	(775)
<i>WANG Han, YU Zhifeng</i>	
<b>Information</b>	
..... (783)(784)(785)(786)	

The *Journal of Medical Biomechanics* (JMB) is sponsored by Shanghai Jiao Tong University and supervised by Ministry of Education of the People's Republic of China. The copyright is reserved by Editorial Office of *Journal of Medical Biomechanics*. No contents are allowed to be reproduced or transmitted in any form or by any means, electronic or mechanical, for any purpose, without the written permission from the publisher.

All manuscripts are reviewed by two or three independent expert reviewers. The information presented in the papers and the opinions expressed therein are those of the individual authors and not necessarily reflect the views of the Editorial Board of *Journal of Medical Biomechanics*. The publisher assumes no liability for any materials published in the journal. All statements are the responsibilities of the authors, particularly the corresponding author (s).

JMB is the source journal for Chinese Scientific and Technical Papers and Citations, and is selected in the *Guide to the Core Journals of China* by Peking University Library. It has been included in certain famous databases such as China Science Citation Database (CSCD) and Scopus.

This journal is printed on acid-free papers.