

Biomechanics: Principles and Applications

Selected Proceedings of the 3rd General Meeting of the European Society of Biomechanics
Nijmegen, The Netherlands, 21-23 January 1982

Dr. van der

edited by

Rik Huiskes

Faculty of Medicine
University of Nijmegen, The Netherlands

Dick H. van Campen

Faculty of Mechanical Engineering
Twente University of Technology, The Netherlands

Joost R. de Wijn

Faculty of Dentistry
University of Nijmegen, The Netherlands



UNIVERSITÄTSBIBLIOTHEK
HANNOVER
TECHNISCHE
INFORMATIONSBIBLIOTHEK

1982

Martinus Nijhoff Publishers

The Hague/Boston/London

TABLE OF CONTENTS

PREFACE	ix
I. 'KEYNOTE' ARTICLES	
1. Perspectives in measurements and modeling of musculoskeletal joint dynamics, <i>E.Y.S. Chao and K.N. An</i>	1
2. Perspectives in biomechanics applied to sport and physical education, <i>B.M. Nigg</i>	19
3. Perspectives in human-joint kinematics, <i>A. Huson</i>	31
4. Advanced theoretical and experimental techniques in cartilage research, <i>V.C. Mow, W.M. Lai, and M.H. Holmes</i>	47
5. Bone as a mechanical structure, <i>J.D. Currey</i>	75
6. Bioengineering considerations in the use of major bone and joint prostheses - 32 years experience, <i>J.T. Scates and K.W.J. Wright</i>	87
7. Perspectives of soft tissue mechanics, <i>Y.C. Fung</i>	95
8. Pressure-flow relations of arterial system and heart, <i>N. Westerhof</i>	115
II. MUSCULO-SKELETAL PERFORMANCE	
9. SIMU - an interactive computer graphics simulation of human gait, <i>R.P. Wells, D.A. Winter, and S. Onyshko</i>	129
10. Standardization of gait kinematic data using a gait symmetry index and Fourier analysis, <i>K. Soudan</i>	135
11. Spinal loading during abnormal walking, <i>A. Cappozzo and F. Gazzani</i>	141
12. Afferent contributions to postural tasks, <i>M.H. Vincken, C.C.A.M. Gielen, J.J. Denier van de Gon, and B.M. ter Haar Romeny</i>	149
13. Moment and work of the calf muscles in walking, <i>A.L. Hof, B.M. Geelen, and J.W. van den Berg</i>	155
14. In-vivo investigations on the mechanical function of the tractus iliotibialis, <i>H.A.C. Jacob, A.H. Huggler, and B. Rüttimann</i>	161
15. Optimal initial conditions for the eastern roll high jump, <i>M. Hubbard and J.C. Trinkle</i>	169
III. BIOMECHANICS OF JOINTS	
16. The application of roentgenstereophotogrammetry for evaluation of knee-joint kinematics in vitro, <i>A. de Lange, R. van Dijk, R. Huiskes G. Selvik, and Th.J.G. van Rens</i>	177

17.	The displacement of the bony insertion sites of the anterior cruciate ligament during the flexion of the knee, <i>J.M. Dorlot, P. Christel, A. Meunier, and J. Witvoet</i>	185
18.	Biomechanical Behaviour of the human tarsus related with a new radiological index, <i>R.J. Benink</i>	191
19.	Measurements of twodimensional pressure distributions and contact areas of a joint using a pressure sensitive foil, <i>H.J. Hehne, H. Haberland, W. Hultzsch, and W. Jantz</i>	197
20.	Lumbar spine stability as determined by the axial twist, <i>A.H. Soni, M.R. Gudavalli, J.A. Sullivan, and A.G. Patwardhan</i>	205
IV.	BIOMECHANICS OF BONE	
21.	A dynamic model for a healing fractured tibia, <i>M. Cornelissen, P. Cornelissen, and G. van der Perre</i>	213
22.	Deformational behaviour of tibio-fibular frames: the influence of anatomic variables, <i>A. Hermanne, R. Bourgois, and J. Wagner</i>	219
23.	Influence of age on bone strength in rats, <i>A. Ekeland, L.B. Engesaeter, and N. Langeland</i>	227
24.	Holographic study of the stresses in the normal pelvis with particular reference to the movement of the sacrum, <i>S. Vukicević, W. Plitz, D. Vukicević, I. Vinter, and M. Bergmann</i>	233
25.	In vivo intracortical loading histories calculated from bone strain telemetry, <i>W.E. Caler, D.R. Carter, R. Vasu, J.C. McCarthy, and W.H. Harris</i>	241
26.	Fracture mechanics of cortical bone, <i>J.C. Behiri and W. Bonfield</i>	247
27.	A composite model of cortical bone for the prediction of crack propagation, <i>H.J. Grootenboer and A.F.J. Weersink</i>	253
28.	Structural and biomechanical analysis of osteonic compact bone: a new method, <i>M. Portigliatti Barbos, P. Bianco, and A. Ascenzi</i>	261
29.	The influence of immobilization on the mechanical and morphological properties of bone, <i>L. Claes and C. Burri</i>	267
V.	ORTHOPAEDIC IMPLANTS AND FRACTURE FIXATION	
30.	The mechanical performance of solid and porous bone cement, <i>J. Ypma, J.R. de Wijn, and R. Huiskes</i>	275
31.	Stress analysis in ceramic hip-joints heads of various shape and fitting, <i>U. Soltesz and G. Heimke</i>	283
32.	Dimensions of the femoral condyles, <i>U.P. Wyss, M. Doerig, O. Frey, and N. Gschwend</i>	291

33.	Micromovement of the tibial component in successful knee arthroplasty, studied by roentgen stereophotogrammetry, <i>L. Ryd, A. Lindstrand, and G. Selvik</i>	299
34.	Stress analysis in artificial knee joints with fixed and movable axis using the finite element method, <i>H. Röhrle, W. Sollbach, and J. Gekeler</i>	305
35.	Quasi two-dimensional finite element analyses and experimental investigation of the tibial part of knee endo-prostheses with intramedullary stems, <i>H.W. Croon, D.H. van Campen, J. Klok, and R. Miehleke</i>	313
36.	Stress distributions in fractures generated by bone plates, <i>U. Soltesz, H.J. Hehne, R. Desiderato, and J. Riedmüller</i>	319
37.	Biomechanical and mathematical investigations concerning stress protection of bone beneath internal fixation plates, <i>L. Claës, U. Palme, E. Palme, and U. Kirschbaum</i>	325
38.	Dynamic fracture loading during gait in a cast-brace: a clinical and biomechanical study, <i>D.J. Pratt, P. Bowker, J.M. Scott, D. Wardlaw, and J. McLaughlan</i>	331
VI. CARDIO-VASCULAR BIOMECHANICS		
39.	Wave structure in the aorta with initial axial tension, <i>E. Barta, M. Israeli, and Y. Kivity</i>	339
40.	Nonlinear wave propagation in the aorta with initial loading, <i>D. Elad, Y. Kivity, A. Foux, and Y. Lanir</i>	345
41.	Transient haemorheology, application to cardiovascular diseases, <i>J.C. Lelievre, C. Lacombe, and D. Quemada</i>	353
42.	Spectrum analysis of turbulence in the aorta, <i>T. Yamaguchi, S. Kikkawa, K. Tanishita, M. Sugawara, and K.H. Parker</i>	359
43.	Cardiac wall mechanics and torsion of the left ventricle during ejection, <i>T. Arts, S. Meerbaum, R.S. Reneman, and E. Corday</i>	367
44.	Mechanical properties of collapsible tubes and propagation of large amplitude waves, <i>P. Flaud, D. Geiger, and C. Oddou</i>	373
45.	Propagation and reflection characteristics of the human aorta, <i>D.L. Newman and S.E. Greenwald</i>	381
VII. MISCELLANEOUS SUBJECTS		
46.	Tendon forces balancing a force on the fingertip, <i>C.W. Spoor</i>	389

47.	Roentgen stereophotogrammetry and metallic implants applied to patients with craniofacial anomalies, <i>B. Rune, K.-V. Sarnäs, G. Selvik, and J. Jacobsson</i>	397
48.	Biomechanical analysis of the deformation of the lower uterus during labour, <i>J.M. Egan and J.D. Richardson</i>	403
49.	The angular distribution function of the elastic fibres in the skin as estimated from in vivo measurements, <i>J.F.M. Manshot, P.F.F. Wijn, and A.J.M Brakkee</i>	411
50.	Rheology of digital flexor tendons of the horse, <i>D.J. Riemersma, D.M. Badoux, W. Hartman, H.C. Schamhardt, and G.J. Molenaar</i>	419
51.	Biomechanical and biomedical features of human sclera, <i>J. Saulgozis and R. Volkolakova</i>	425
52.	Intraocular dynamics of the aphakic eye, <i>J. Larsen</i>	433
53.	Principle characteristics of the stress distributions in the jaw caused by dental implants, <i>U. Soltesz and D. Siegele</i>	439
54.	The mechanics of retraction components used in fixed appliance therapy, <i>N.E. Waters</i>	445
55.	A mechanical investigation to the functioning of mouthguards, <i>J.R. de Wijn, M.M.A. Vrijhoef, P.A. Versteegh, H.P. Stassen, and E.W. Linn</i>	451