

# Department of Orthopedics in the Malteser Waldkrankenhaus St. Marien gGmbH

## Chair of Orthopedics and Orthopedic Surgery

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### Research focus

- Roentgen-Stereophotogrammetric-Analysis (RSA) for quality control in total hip and knee arthroplasty
- Neuromuscular disorders
- Gait- and posture analysis

### Structure of the Department

Professorship: 1  
Personnel: 9

- Doctors (of Medicine): 3
- Scientists: 1
- Graduate students: 32 / Graduations 9
- post-doctoral qualification applicants: 1 / post-doctoral qualifications 3

### Clinical focus areas

- Hip, knee and shoulder arthroplasty
- Knee and shoulder surgery
- Arthroscopic surgery
- Foot surgery
- Pediatric orthopedics
- Neuromuscular disorders
- Conservative and technical orthopedics
- Orthopedic pain management

### Research

The Department of Orthopedics deals with innovative research questions concerning in vivo diagnostics and therapy within the field of total hip and knee arthroplasty. Main topics represent the assessment of in vivo implant migration and implant safety, the preoperative planning of total hip and knee arthroplasty and spinal intervertebral fusions as well as gait and posture analysis. Additionally clinical studies within the field of neuromuscular diseases were performed.

Research staff is organized within the „Research Network Musculoskeletal Biomechanics (MSB-NET)“ of the German Society for Orthopedics and Traumatology (DGOU) and have exchange opportunities with similar national research institutions.

### Roentgen-Stereophotogrammetric-Analysis (RSA) for quality control in total hip and knee arthroplasty

PI: Prof. Dr. R. Forst, PD Dr. F. Seehaus

Implantation and revision statistics for total hip and knee arthroplasty have shown a continuous increase within the recent years. Aseptic implant loosening is a clinical challenge and still one of the most common causes of total joint arthroplasty revision surgery. By Roentgen-Stereophotogrammetric-Analysis (RSA) method, it is possible to assess clinically the in vivo implant fixation of a new implant designs or coatings within the first two postoperative years. The RSA method allows an accurate in vivo measurement of the relative implant-to-bone movement, the so-called implant migration. It has been shown scientifically that the continuously increasing early implant migration correlates very well with a later aseptic loosening within the first two postoperative years, which predicts RSA as a reliable surrogate marker for later aseptic loosening of the implant. The current focus of RSA research at the Department of Orthopedics is on the experimental validation of new RSA approaches as well as the clinical assessment of in vivo migration of total hip arthroplasty. Currently, an RSA approach is being experimentally and clinically validated, which uses a generated implant model based on elementary geometrical shapes (EGS) and uses this to determine migration. Methodological limits and further possibilities for assessing implant safety using the RSA-EGS approach were demonstrated.

In addition to the classic application of the RSA method to assess the in vivo implant fixation, the Department of Orthopaedics uses RSA approach to determine the in vivo wear behaviour of THA bearings and to determine the in vivo implant kinematics.

The Department of Orthopedics collaborates with the Laboratory for Biomechanics and Biomaterials of Hannover Medical School, Laboratory for Biomechanics and Implant Research of the Orthopedic University Hospital Heidelberg and the Institute of Medical Technology of Ostbayerische Technische Hochschule Amberg-Weiden.

### Neuromuscular disorders

PI: Prof. Dr. J. Forst, Dr. A. Fujak, Prof. Dr. R. Forst  
The research group for neuromuscular disorders is engaged in an evaluation of orthopedic symptoms, conservative and operative treatment in children and adult patients with neuromuscular disorders. The aim of research is the optimization of orthopedic treatment, improvement of the medical care and quality of life of these patients. The studies are particularly focused on anterior horn cell diseases, spinal muscular atrophies, post-polio syndrome, hereditary neuropathies and muscular dystrophies. Although knowledge of the gene defect and the coded protein – the dystrophin – is given, there is no causal therapy of Duchenne muscular dystrophy (DMD) – the most common neuromuscular disease. The natural history of this disease includes beside the obligatory restrictive respiratory insufficiency the cardiomyopathy contractures of the extremities and progressive scoliosis in almost all patients.

The results of operative treatment of contractures of lower extremities particularly in early course of the disease are investigated in a prospective study

in a collective of more 500 patients with genetically confirmed diagnosis of DMD. Positive effect of this treatment could be proven, and a stage-oriented therapy concept could be developed.

In close cooperation with the Department of Anesthesiology, the special features in anesthesia and pain therapy in patients with the neuromuscular disorders are investigated. In common projects with the Division of Pediatric Cardiology and the Institute of Radiology, the participation of the heart musculature in DMD is examined.

### Gait and posture analysis

PI: PD Dr. F. Seehaus, Prof. Dr. R. Forst, PD Dr. A. Fujak

The Department of Orthopaedics cooperates here on a national level with the gait laboratory of the Orthopaedic Children's Hospital in Aschau (Dr. C. Dussa; PD Dr. habil H. Böhm), and internationally with the University of Physical Education in Warsaw, Poland.

Questions onto the assessment and classification of gait pathologies, applicability and efficiency of orthopaedic aids or the review of surgical treatments. For the assessment of in vivo implant kinematics, an initial measurement and information system was set up and validated as part of a student project in the medical technology course.

### Teaching

The Department of Orthopedics participates within the curricular teaching of Medicine. To increase interdisciplinary teaching at FAU, interdisciplinary courses for students of Medicine and medical technology are held in cooperation with the Faculty of Engineering. Lecture and seminar are open to students of medical technology, as well as materials scientists, industrial engineers, mechanical engineers, or mechatronics.

The existing curriculum for medical students (internship at Department of Orthopedics) is continuously expanded by practical exercises/laboratories, likewise the „Skillslab Fracture Treatment“. Within this course, students should be trained first practical skills in the field of plate osteotomy and or the implantation of total knee and hip arthroplasty using Saw-Bones.

In addition Bachelor's and Master's theses from students of the Faculty of Engineering as well as medical dissertations are supervised. Currently, five Chinese guest physicians (PhD Fellowships), 32 doctoral students, and 1 postdoctoral qualification applicant are supervised by the Department of Orthopedics.

Results of current projects were presented by research staff and PhD students at national and international conferences.

### Selected publications

Xu J, Sonntag R, Kretzer JP, Taylor D, Forst R, Seehaus F. Model-based Roentgen Stereophotogrammetric Analysis to monitor in vivo the Head-Taper junction in Total Hip Arthroplasty – and they do move. *Materials*. 2020, 13(7):1543.

Seehaus F, Sonntag R, Schwarze M, Jakubowitz E, Sesselmann S, Kretzer JP, Hurschler C. Früherkennung des Risikos der späteren Implantatlockerung mittels der Röntgen Stereophotogram-metrischen Analyse (RSA). Orthopäde. 2020, 49(12):1042-1048.

Hüttel M, Golditz T, Mayer I, Heiss R, Lutter C, Hoppe MW, Engelhardt M, Grim C, Seehaus F, Forst R, Hotfiel T. Effects of Pre- and Post-Exercise Cold-Water Immersion Therapy on Passive Muscle Stiffness. Sportverletz Sportschaden. 2020, 34(2):72-78.

Dussa CU, Böhm H, Döderlein L, Forst R, Fujak A. Does an overcorrected clubfoot caused by surgery or by the Ponseti method behave differently? Gait Posture. 2020, 77:308-314.

Böhm H, Döderlein L, Fujak A, Dussa CU. Is there a correlation between static radiographs and dynamic foot function in pediatric foot deformities? Foot Ankle Surg. 2020, 26(7):801-809.

#### **International cooperation**

Dr. I. Wiszomirska, Józef Piłsudski University of Physical Education, Warsaw: Poland