

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
- Preoperative planning of total joint arthroplasty

Structure of the Department

Professorship: 1

Personnel: 8

- Doctors (of Medicine): 3
- Graduate students: 41

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, 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 in-

stitutions. Currently, the Department of Orthopedics provides the speaker of MSB-nets cluster „Implant fixation and Implant safety“.

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

PI: Prof. Dr. R. Forst, 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.

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 dis-

ease. 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.

Preoperative planning of total joint arthroplasty

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

Preoperative planning of total hip or knee arthroplasty is carried out within clinical practice two-dimensionally with the aid of planning software using conventional X-ray images (a.p. pelvis overview or whole-leg image in combination with a m.l. knee x-ray). In the case of severe anatomical deformities within the region of the hip or knee joint, two-dimensional planning is often difficult. Currently, three-dimensional preoperative planning of total joint arthroplasty is propagate and suggested by the medical industry. For a three-dimensional planning approach, a CT data set of the joint is required for, which is accompanied by an additional radiation exposure for the patient.

Aim of the project is the clinical validation (retrospective) of the three-dimensional planning environment in the field of total hip and knee arthroplasty or spinal intervertebral fusion.

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. Currently the concept of a so called „Saw-Bone-Lab“ is validated for the medical students. Within this course, students should be trained 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, six Chinese guest physicians (PhD Fellowships), 41 doctoral students, and 3 post-doctoral qualification applicants 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

Mauerer A, Stenglein S, Schulz-Drost S, Schörner C, Taylor D, Krinner S, Heidenau F, Adler W, Forst R. Antibacterial Effect of a 4x Cu-TiO₂ Coating Simulating Acute Periprosthetic Infection-An Animal Model. *Molecules*. 2017, 22(7). pii: E1042

Dussa CU, Döderlein L, Forst R, Böhm H, Fujak A. Management of Severe Equinovalgus in Patients With Cerebral Palsy by Naviclectomy in Combination With Midfoot Arthrodesis. *Foot Ankle Int*. 2017, 38(9):1011-1019

Jacobsen A, Seehaus F, Hong Y, Cao H, Schuh A, Forst R, Sesselmann S. Model-based roentgen stereophotogrammetric analysis using elementary geometrical shape models: 10 years results of an uncemented acetabular cup component. *BMC Musculoskelet Disord*. 2018, 19(1):335

Sommer C, Geber C, Young P, Forst R, Birklein F, Schoser B. Polyneuropathies. *Dtsch Arztebl Int*. 2018, 115(6):83-90

Sesselmann S, Hong Y, Schlemmer F, Hussnaetter I, Mueller LA, Forst R, Tschunko F. Radiostereometric migration measurement of an uncemented Cerafit® femoral stem: 26 patients followed for 10 years. *Biomed Tech (Berl)*. 2018, 63(6):657-663

Hotfiel T, Heiss R, Janka R, Forst R, Raithel M, Lutter C, Gelse K, Pachowsky M, Golditz T. Acoustic radiation force impulse tissue characterization of the anterior talofibular ligament: a promising noninvasive approach in ankle imaging. *Phys Sportsmed*. 2018, 46(4):435-440

International cooperation

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