

Department of Prosthodontics

Chair of Dental, Oral, and Maxillofacial Medicine - especially Prosthetic Dentistry

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Research Focus

- Dental biomechanics
- Psychogenic influence/quality of life and complementary medical procedures in dental questions
- Optical 3D-measurement technique in dentistry
- CAD/CAM research laboratories
- Prosthodontics and Implant therapy based on 3 dimensional Imaging

Structure of the Department

Professorships: 2

Personnel: 45

- Doctors (of Medicine): 17
- Scientists: 11 (thereof funded externally: 0)
- Graduate students: 10

Clinical focus areas

- Implant prosthetics
- Fixed and removable prosthetic
- Diagnosis and treatment of temporomandibular joint Dysfunction (TMJD)
- Hypnosis and acupuncture treatment
- Esthetic Dentistry
- Prosthetic rehabilitation with epithesis
- Prosthetic rehabilitation of children

Research

Due to the high demands and quality standards of research projects, synergistic effects of highly qualified specialists are mandatory. This is reflected in the general orientation and a focus on future demands as well as in extensive cooperation with other fields of research. One key focus of research is the aging population and the resulting demographic changes and the investigation of the relationship between oral and general health.

Dental biomechanics

Project manager: PD Dr. R. Matta, Dr. C. Motel
Due to the lack of suitable metrological methods, it has so far been possible only to a very limited extent and in individual cases with very complex experimental set-ups to represent and quantitatively determine biomechanical influences in the oral cavity. A large number of theories on a wide variety of questions have so far neither been

clearly confirmed nor refuted scientifically. The aim of the research area is to optimize a renewed, non-contact 3D optical deformation measurement system for clinical in vivo application on patients in order to enable quantitative measurements of biomechanical influences in the oral cavity in real time in future studies and to initiate innovative questions through in vitro investigations. In ongoing and completed in vitro investigations in the fields of material science and biomechanics, the previously existing system has proven its worth. In addition, the first in vivo pilot studies on force-correlated tooth movements have demonstrated a corresponding clinical application. An innovation introduced in the reporting period was the investigation of deformations of implants, superstructures and bone under simulated chewing force, which allows dynamic changes on surfaces to be represented with high precision. For this purpose, the current version of the ARAMIS system from GOM GmbH, which is innovative in dental research, was purchased and already established through its presentation at a specialist congress. The first goal here was to demonstrate the advantages in the field of dental biomechanics over the conventional measuring methods currently used in this field, such as strain gauges. This method opens up a wide range of scientific applications for the future.

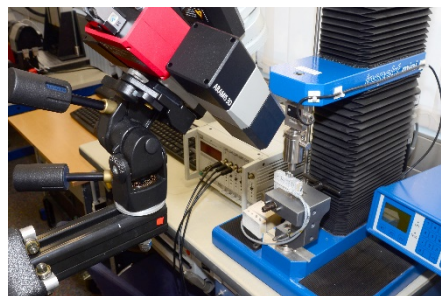


Fig. 1: A new optical 3D measurement technology for biomechanical implant deformation.

Psychogenic impact/quality of life and complementary medical procedures in dental questions

Project manager: Prof. Dr. S. Eitner

This area of research is divided in two main focal points. The first focal point evaluates psychogenic influence on treatment planning and outcome of dental disease patterns with a psychogenic background. Among other factors, the subject's appraisal of his own body can influence dental questions. Besides, the etiological correlation of gag reflexes during dental treatment, the influence of stress and clinical pictures on fear, depressive states, and social parameters are evaluated, too. The second focal point concerns the therapeutic intervention with medical hypnosis and acupuncture in dental treatment and their influence on psycho-social factors as well as pain in above mentioned dental problems.

Optical 3D-measurement technique in digital dentistry

Project managers: PD Dr. R. Matta, Dr. C. Motel, Dr. J. Ries

There is currently a change in technology in the field of dental impression taking. Digital impressions are becoming more established and their indication has been expanded to include multi-unit bridges, extensive implant restorations and bite registration as a result of constant technological progress from single-tooth crowns. This research area evaluates the accuracy of digital impressions taken by intraoral scanners - also in comparison with conventional methods. This involves investigating which scan protocols, i.e. which sequence of work steps, can lead to the best possible digital imaging of the oral situation. In addition, various parameters of digital impression taking are considered, such as the geometry of the scan bodies required for digital implant impression taking and the various intraoral scanners available on the market, in order to assess the quality and reproducibility of this technology.

CAD/CAM research laboratories

Project managers: PD Dr. R. Matta, Dr. L. Berger
Industrial CAD/CAM manufacturing technologies have gained significant market share in producing dental restorations in recent years, primarily due to standardized product quality and precision as well as economic processing routine in dental laboratories. To achieve high quality and precision, product aligned process routes are a mandatory prerequisite. The research group focuses on segmenting CAD/CAM processes and assessment of the impact on the overall quality. In addition to recently developed methodologies for 3D-display and analysis of microgaps in conventional dental restorations, new protocols are in development for a clinical assessment of fit of implant retained superstructures. The research laboratories are equipped with state-of-the-art industrial non-contact scanners and necessary analytical software programs. As high strength oxide ceramics are applied more frequently as framework materials in dentistry, several research projects assess the clinical application and factors influencing longterm success.

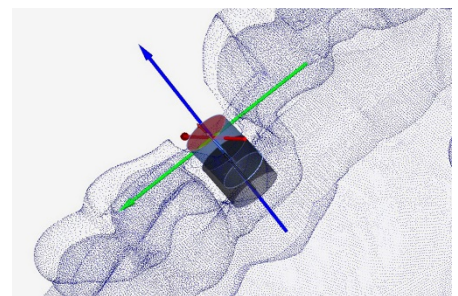


Fig. 2: Comparison of the accuracy of CAD/CAM implant tem-plate to virtual planning.

Prosthodontics and Implant therapy based on 3 dimensional Imaging

Project managers: PD Dr. R. Matta, Dr. A. Seidel, ZÄ S. Knapp
The three dimensional imaging becomes more and

more important for the modern implant and prosthodontic therapy plan. This includes the Computer Tomography (CT), the Cone Beam Computer Tomography (CBCT) and the intraoral digital impression. The focus is on the three dimensional accuracy of the X-ray imaging. In addition, the impact of different dental implant materials on the appearance of artifacts in the 3-dimensional virtual model is investigated. In this context a new method for the 3-dimensional evaluation of CT and CBCT images has been developed. The research in this area is of great importance and interest because the long-term clinical success of prosthodontic and implant restorations depends on the accuracy of the three dimensional transfer of oral structures in "virtual" illustrations.

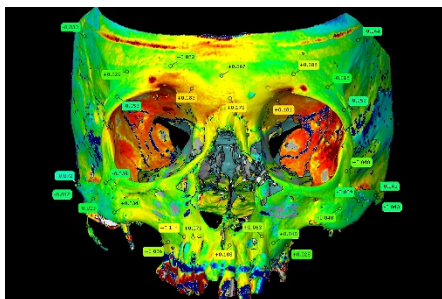


Fig. 3: Illustration of 3 D deviation of CBCT in comparison to optical reference scan.

Functional diagnostics

Project managers: PD Dr. R. Matta, Dr. C. Loibl

The specialty of functional diagnostics is becoming increasingly important and is related to numerous factors, both physical and environmental. Craniomandibular dysfunction, or CMD, is a collective term for a heterogeneous group of disorders that can affect the temporomandibular joint, the masticatory muscles and/or other adjacent structures in the head and neck region. Because the etiology of craniomandibular dysfunction is not yet fully understood, a multifaceted and reversible approach to treatment is recommended. This includes splint therapy, but also manual therapy by specialized physiotherapists. This research area investigates the effects of the different forms of therapy. On the one hand, a back scanner and 3D raster stereography are used to investigate whether and to what extent the various forms of therapy cause changes in posture and individual parameters such as lordosis and kyphosis angles or pelvic rotation. On the other hand, the research area will use scans of the bite situation of patients at different points in time during treatment to examine the extent to which, for example, splint or manual therapy influences the occlusion of the dentition. The aim is to be able to draw conclusions about the extent of the treatment results and their implications for everyday practice.

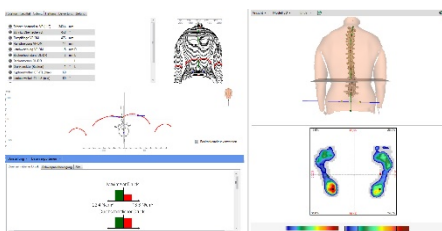


Fig. 4: 3D illustration examples of the spinal reconstruction and foot pressure measurement using the Diers Formetric 4D.

Teaching

The main focus of traditional prosthodontic education has shifted from a technically oriented towards an interdisciplinary treatment approach. Prophylaxis and biology are in the focus as well as minimally invasive treatment concepts. Clinically relevant topics are introduced into the preclinical curriculum, focusing on biologic interactions and material properties. While theoretical knowledge remains integral part of dental education, manual manufacture of dental restoration will be taught only exemplarily. Two new extra-curricular courses have been introduced, through which the new treatment options and theoretical principles of digital dentistry are made available to students of clinical treatment courses in dentistry I and II on a voluntary basis in one-week courses. Doctoral projects are offered at the Chair of Dental Prosthetics within the various research areas and supervised by the scientific staff.

Selected Publications

Motel C, Kirchner E, Adler W, Wichmann M, Matta RE. Impact of Different Scan Bodies and Scan Strategies on the Accuracy of Digital Implant Impressions Assessed with an Intraoral Scanner: An In Vitro Study. J Prosthodont. 2020 Apr;29(4):309-314.

Wolf L, Bergauer B, Adler W, Wichmann M, Matta RE. Three-dimensional evaluation of mandibular deformation during mouth opening. Int J Comput Dent. 2019;22(1):21-27.

Matta RE, Motel C, Kirchner E, Stelzer SP, Adler W, Wichmann M, Berger L. Wear of feldspathic-ceramic-veneered zirconia posterior FPDs after 10 years. BMC Oral Health. 2020 Nov 30;20(1):345.

Schmitt CM, Brückbauer P, Schlegel KA, Buchbender M, Adler W, Matta RE. Volumetric soft tissue alterations in the early healing phase after peri-implant soft tissue contour augmentation with a porcine collagen matrix versus the autologous connective tissue graft: A controlled clinical trial. J Clin Periodontol. 2021 Jan;48(1):145-162.