Translational Research (TR) Applications in Biomedical Engineering

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// Introduction

Medical Image Processing
- **Increasingly important / helps to analyze medical image data**
- **Improved imaging / faster hardware enables reasonable data processing**

Medical decisions
- **Computer-aided support in all treatment stages**
- **Diagnosis, monitoring, therapy planning, execution and follow-up examinations**

Motivation for this work
- **Support the computer-aided treatment of cranial and facial defects**
- **Translational contributions in all therapy phases**

// Example Applications

- Interactive facial Reconstructions
- Planning of cranial 3D implants
- Medical Augmented Reality (AR) and Virtual Reality (VR)

// Facial Reconstructions

- Predefined 3D models of real implants / miniplates
- Interactive placement (translation / rotation) on CT acquisition of the patient
- Saving / export for additional 3D printing and evaluation of the implant

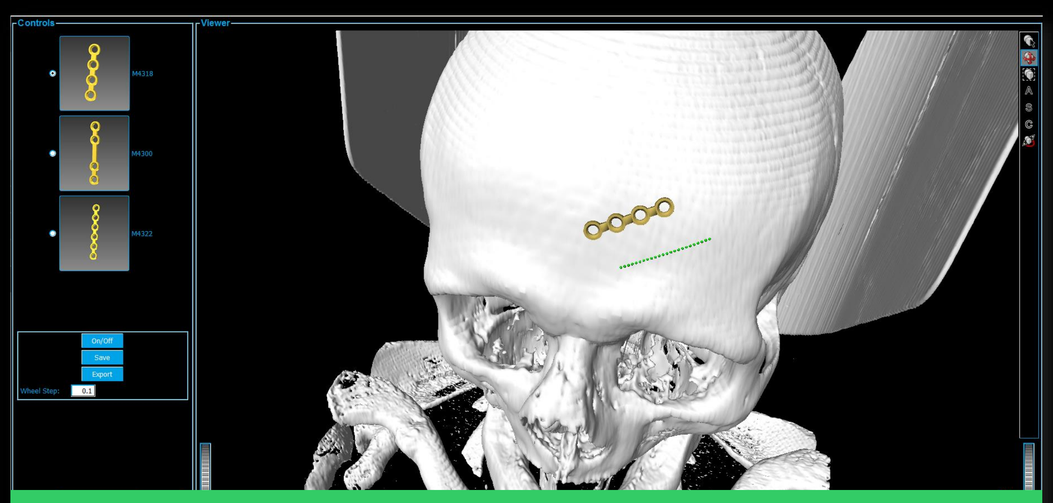

Figure 1 – Comprehensive user interface for the interactive planning of miniplates

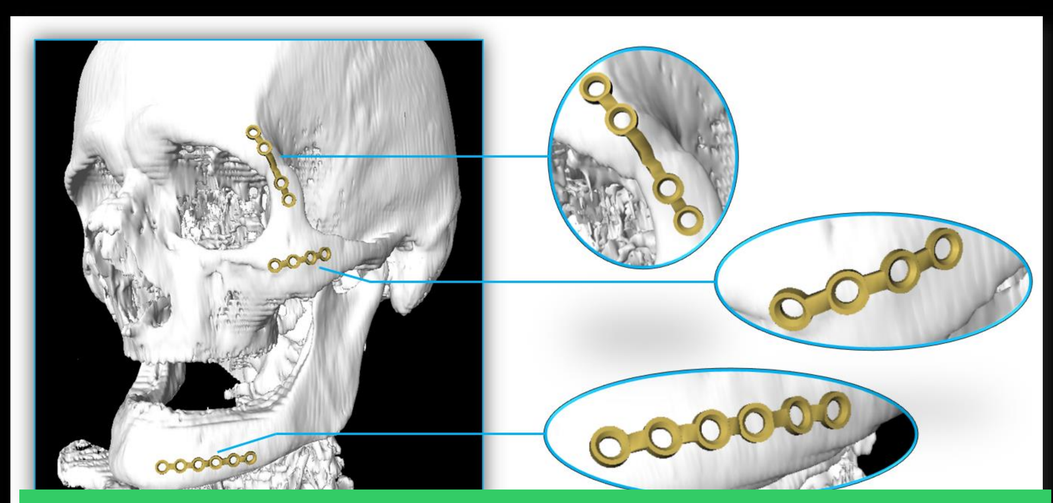

Figure 2 – Patient's data set with applied miniplates (gold) on several locations where fractures occur frequently

// Cranial 3D Implants

- Patient-individual implant planning: mirroring, refining and smoothing
- Custom-defined cutting planes for optimal implant visualization and assessment
- Precise outer and inner implant refinement options for an user
- Saving / exporting for additional 3D printing and evaluation purposes

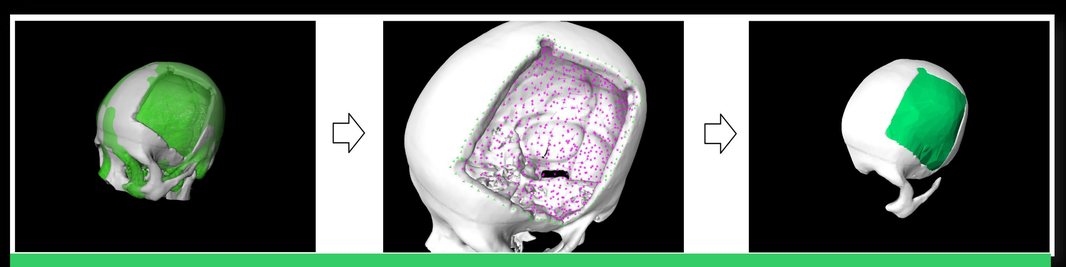

Figure 3 – Cranial implant generation process for a clinical case with a cranial defect on the left side

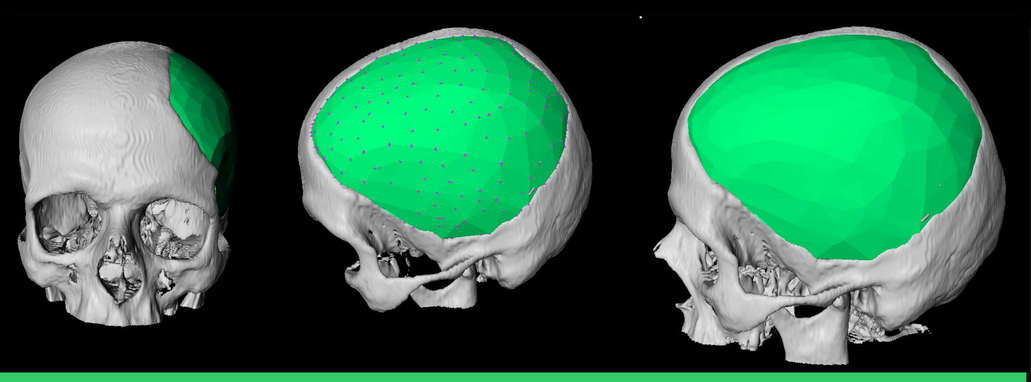

Figure 4 – Detailed implant planning results for a clinical case with a large cranial defect on the left and upper side

// Medical Augmented and Virtual Reality

- Augmented and immersive computer technologies
- Enhance / replicate an environment via computer-simulated reality
- Supports complex surgical interventions: planning, simulation and training

Figure 5 – HoloLens

Figure 6 – HTC Vive

// Conclusion

- Strong collaboration with clinical partners from the Medical University of Graz
- Research and development (R&D) of several clinical prototypes
- Evaluation and testing with real patient datasets from the clinical routine
- Successful completion of student projects and bachelor / master theses
- Several publications in national and international conferences and journals

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Videos and Video Tutorials

https://www.youtube.com/c/JanEgger/videos

Acknowledgements

BioTechMed-Graz ("Hardware accelerated intelligent medical imaging") and the 6th Call of the Initial Funding Program from the Research & Technology House (F&T-Haus) at the Graz University of Technology (PI: Dr. Dr. Jan Egger)

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