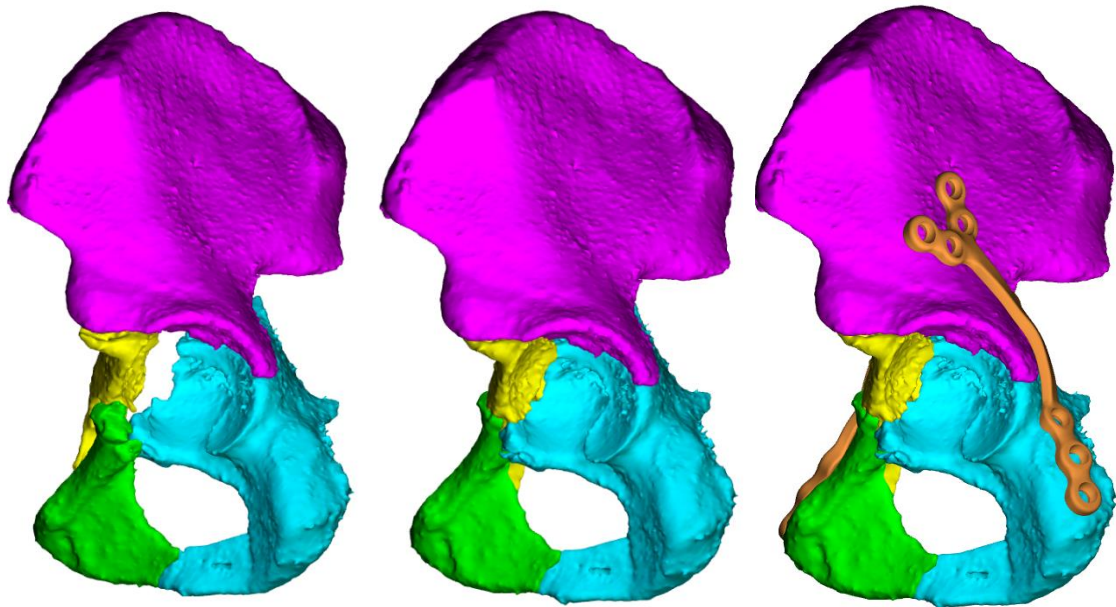# Master thesis Technical Medicine

Trauma Surgery department
Oral and Maxillofacial Surgery department
3D lab at the University Medical Center Groningen
Faculty of Science and Technology at the University of Twente

Three-dimensional computed tomography measurements of acetabular fractures

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UNIVERSITY OF TWENTE.

3D Lab
Patient Care & Innovation

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Preface

In September 2014, I started with the master track Medical Imaging and Interventions of the master Technical Medicine. After a year of courses and learning practical skills I did four internships, that took ten weeks each, at four different hospitals in the Netherlands. In the final year of my master I did a 40 week graduation internship at the Trauma Surgery department at the University Medical Center Groningen.

My main research topic was the three-dimensional analysis of acetabular fractures, which is described in this thesis. Besides conducting this research, I also gained clinical experience during the 40 week internship. For example, I had the opportunity to watch and assist during surgeries and I participated in consultation hours. I also participated in a project focused on designing patient-specific pelvic plates. On top of that, I did the virtual planning of corrective osteotomies and I created virtual 3D models that were used during surgery and sometimes even for the pre-bending of a plate for surgery. All of this would not have been possible without the help of multiple people.

I would like to thank Frank IJpma for his enthusiasm about the project and for the opportunities he gave me to watch and assist during surgeries and to see patients during consultation hours. I would also like to thank him for all the knowledge he gave me about acetabular fractures amongst other things, for the discussions about the project and the hours we spend studying patient files. A special thanks for all your efforts to find financial support to be able to continue the project after my graduation and for sending in the application for the innovation price.

Next I thank Joep Kraeima for his enthusiasm and for being an example of how I think technical physicians can aid in healthcare. Thank you also for helping me with making myself indispensable as a technical physician for the Trauma Surgery and for assisting with the virtual planning of the corrective osteotomies.
Thanks to Max Witjes for his enthusiasm and involvement in the project. Also thank you for the discussions and feedback and the aid in finding financial support.

Thank you Paul van Katwijk for helping me to develop myself as a technical physician and to learn about myself, my qualities and learning goals. In order to achieve this I did a self-reflection after all the shorter internships and learned that I developed myself on different levels.
Thanks to Kees Slump for his technical support and feedback, and also for about the financial support to continue the project.
Anique Bellos-Grob, thanks for participating by being an external member in the graduation committee.

Also thanks to Hester Banierink and Kaj ten Duis for their support, feedback and cooperation in the project.
Thanks to all my colleagues at the 3D lab, Oral and Maxillofacial Surgery department and the Trauma Surgery department for the opportunity to do my internship there. Also thanks for the feedback and discussions about my project and for the clinical experiences I gained.

Finally I would like to thank my mother and her partner, my boyfriend and my sisters for all their support and for always being there for me. I could not have done it without you!

Graduation committee

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List of abbreviations

2D	Two-Dimensional
3D	Three-Dimensional
DICOM	Digital Imaging and Communications in Medicine
CT	Computed Tomography
ICC	Intraclass Correlation Coefficient
HET	High Energy Trauma
LET	Low Energy Trauma
Q3DCT	Quantitative Three-Dimensional Computed Tomography
HU	Hounsfield Units
GLM	General Linear Model
SLS	Selective Laser Sintering
mm	Millimeters

Table of Contents:

Thesis outline

The first part of my thesis includes the article I wrote about the three-dimensional analysis of acetabular fractures. For all patients, a postoperative evaluation of the acetabular fracture was performed and a typical example is shown in Appendix I. The table with the results for all individual patients is included in Appendix II and in Appendix III the profile plots are included. In addition to my project, I also participated in other projects, which are described in Appendix IV up to VII. In Appendix IV the process of designing the 3D patient-specific pelvic plates and my role in the process is described. In Appendix V the pre-bending of pelvic plates using a 3D printed models will be explained and in Appendix VI the corrective osteotomies will be explained. Finally, in Appendix VII a few examples of the 3D models I have created are shown.