



Universiteit  
Leiden  
The Netherlands

## **Roentgen stereophotogrammetric analysis to study dynamics and migration of stent grafts**

Koning, O.H.J.

### **Citation**

Koning, O. H. J. (2009, June 25). *Roentgen stereophotogrammetric analysis to study dynamics and migration of stent grafts*. Retrieved from <https://hdl.handle.net/1887/13870>

Version: Corrected Publisher's Version

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/13870>

**Note:** To cite this publication please use the final published version (if applicable).

**Roentgen stereophotogrammetric analysis  
to study  
dynamics and migration of stent-grafts**

**Olivier H.J. Koning**

Printing of this thesis was financially supported by:

Medtronic Trading BV, W.L. Gore & Associates, Angiocard, Vasutek Nederland BV,

Abbott Vascular BV, Medis specials bv, B.Braun, LeMaitre Vascular, Bard Medical, Baxter

Copyright: Olivier H.J. Jan Koning ©2009

ISBN 978-90-8559-527-4

Cover, Lay-out and printing: Optima Grafische Communicatie, Rotterdam, The Netherlands

Front: Pulsatile model for stent-graft migration measurement (photograph: O.H.J. Koning)

Back: Schematic representation of reconstruction of the position of stent-graft markers (B.L. Kaptein)

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronically, mechanically, by photocopying, recording or otherwise, without the prior written permission of the author.

# **Roentgen Stereophotogrammetric Analysis to study Dynamics and Migration of Stent-Grafts**

PROEFSCHRIFT

ter verkrijging van  
de graad van Doctor aan de Universiteit Leiden,  
op gezag van Rector Magnificus prof. mr. P.F. van der Heijden,  
volgens besluit van het College voor Promoties  
te verdedigen op donderdag 25 juni 2009  
klokke 15.00 uur

door

**Olivier Henk Jan Koning**

geboren te Amsterdam

in 1970

**Promotiecommissie:**

Promotor: Prof. Dr. J.H. van Bockel

Copromotor: Dr. E.R. Valstar

Referent: Prof. Dr. M. Malina (UMAS, Malmö University Hospital, Malmö, Zweden)

Overige leden: Prof. Dr. J.F. Hamming

Prof. Dr. J.H.C. Reiber

Prof. Dr. H.J.M. Verhagen (Erasmus Medisch Centrum, Rotterdam)

*Voor Wally*  
*Aan Wally, Charlotte en Juriaan*



# Contents

CHAPTER 1	9
General Introduction	
CHAPTER 2	25
Technique of RSA and FRSA	
<b>PART I</b>	37
Surveillance of stent-graft migration after EVAR	
CHAPTER 3	39
Roentgen Stereophotogrammetric Analysis: an accurate tool to assess endovascular stent-graft migration	
<i>Journal of Vascular and Endovascular Therapy 2006;13:468-475</i>	
CHAPTER 4	53
Accurate detection of stent-graft migration in a pulsatile aortic model using Roentgen Stereophotogrammetric Analysis	
<i>Journal of Vascular and Endovascular Therapy 2007;14:30-38</i>	
CHAPTER 5	69
Roentgen Stereophotogrammetric Analysis to detect and quantify stent-graft migration in an animal model	
<i>Submitted</i>	
CHAPTER 6	81
Accurate Roentgen Stereophotogrammetric Analysis of stent-graft migration using a single aortic reference marker	
<i>Submitted</i>	
CHAPTER 7	93
Plain radiographic images have insufficient accuracy and precision to detect stent-graft migration	
<i>Submitted</i>	



<b>PART II</b>	105
Quantification of 3-D stent-graft dynamics using Fluoroscopic Roentgen Stereophotogrammetric Analysis	
CHAPTER 8	107
Assessment of 3-D stent-graft dynamics using Fluoroscopic Roentgen Stereophotogrammetric Analysis (FRSA)	
<i>Journal of Vascular Surgery 2007;46:773-779</i>	
CHAPTER 9	123
Fluoroscopic Roentgen Stereophotogrammetric Analysis (FRSA) to study 3-D stent-graft dynamics in patients, a pilot study	
<i>Journal of Vascular Surgery 2009, in press</i>	
<b>ADDENDUM</b>	139
EVAR and radiation risks	
CHAPTER 10	141
Endovascular abdominal aortic aneurysm repair: patient dose and radiation risks	
<i>Submitted</i>	
CHAPTER 11	155
Summary, future aspects and conclusions	
CHAPTER 12	169
Samenvatting, toekomst perspectieven en conclusies	
CHAPTER 13	181
Acknowledgements	
List of publications by the author	
Curriculum Vitae	