



Universiteit
Leiden
The Netherlands

Unravelling the collagen network of the arterial wall

Beenakker, J.W.M.

Citation

Beenakker, J. W. M. (2012, June 5). *Unravelling the collagen network of the arterial wall*. *Casimir PhD Series*. Retrieved from <https://hdl.handle.net/1887/19050>

Version: Not Applicable (or Unknown)

License: [Leiden University Non-exclusive license](#)

Downloaded from: <https://hdl.handle.net/1887/19050>

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

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/19050> holds various files of this Leiden University dissertation.

Author: Beenakker, Jan Willem Maria

Title: Unravelling the collagen network of the arterial wall

Date: 2012-06-05

Unravelling the collagen network of the arterial wall

Unravelling the collagen network of the arterial wall

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 dinsdag 5 juni 2012
klokke 16:15 uur

door

Jan Willem Maria Beenakker

geboren te Leiden
in 1984

Promotiecommissie

Promotor: Prof. dr. ir. T. H. Oosterkamp
Co-promotor: Dr. J. H. Lindeman (*Leids Universitair Medisch Centrum*)
Overige leden: Prof. dr. E. R. Eliel
Prof. dr. P. Eriksson (*Karolinska Institutet, Zweden*)
Prof. dr. J. W. M. Frenken
Prof. dr. G. H. Koenderink (*Vrije Universiteit Amsterdam, AMOLF*)
Dr. ir. S. J. T. van Noort
Dr. C. Storm (*Technische Universiteit Eindhoven*)

Casimir PhD series, Delft-Leiden 2012-11

ISBN 978-90-8593-123-2

An electronic version of this thesis can be found at <https://openaccess.leidenuniv.nl>

The work described in this thesis was performed at the Huygens Laboratory, Leiden Institute of Physics, Leiden University, The Netherlands, and was financially supported by a Netherlands SmartMix grant and the NIMIC partner organizations.

ad majorem Dei gloriam

Contents

1	Introduction	1
2	Background	5
2.1	The aorta	6
2.2	The physics of networks	10
2.3	The approach of this thesis	13
2.4	References	17
3	Methods	23
3.1	Atomic Force Microscopy	24
3.2	Fluorescence microscopy	33
3.3	Sample preparation	36
3.4	References	37
4	Aneurysms of the abdominal aorta	41
4.1	Abstract	42
4.2	Introduction	42
4.3	Results	43
4.4	Discussion	48
4.5	Materials and Methods	51
4.6	Supporting Information	51
4.7	References	57
5	Proteolytic treatments on the aortic wall	61
5.1	Abstract	62
5.2	Introduction	62
5.3	Materials and Methods	63
5.4	Results and Discussion	65
5.5	Conclusion	72
5.6	Supporting material	72
5.7	Acknowledgements	74
5.8	References	74

6	Atherosclerotic plaques	77
6.1	Abstract	78
6.2	Introduction	78
6.3	Methods	79
6.4	Results	83
6.5	Discussion	90
6.6	Supplementary methods	92
6.7	Plaques of the abdominal aorta	96
6.8	Acknowledgments	99
6.9	References	99
7	Tumor micrometastasis in zebrafish	103
7.1	Abstract	104
7.2	Introduction	104
7.3	Results	105
7.4	Discussion	116
7.5	Materials and Methods	117
7.6	Possibilities for new studies	120
7.7	Acknowledgements	122
7.8	References	122
8	Epilogue	125
	Samenvatting	130
	Summary	134
	Curriculum Vitæ	138
	List of publications	139