

An evaluation of non-invasive vascular assessment methods for detecting peripheral arterial disease in the lower limb

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Statement of originality

I declare that this work is wholly original and is all my own work and to the best of my knowledge contains no materials previously written or published by other persons. Any and all assistance in the preparation of this work has been acknowledged. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository**, subject to the provisions of the Copyright Act 1968.

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Statement of Collaboration

I hereby certify that the work embodied in this thesis has been done in collaboration with other researchers. I have included as part of the thesis a statement clearly outlining the extent of collaboration, with whom and under what auspices.

15th April 2016

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Overall I hope that this work encourages podiatrists in all areas of practice, public and private, to complete more accurate and timely non-invasive vascular assessments to ensure better outcomes in our patients and in turn reduce the number of preventable amputations. Although it may not be the most glamorous aspect of podiatry, I have always felt passionate about this area of practice, as ultimately what can be more rewarding than saving someone’s feet from amputation? I hope this thesis enables more podiatrists to do just that.

Contents

Statement of originality	ii
Statement of Collaboration.....	ii
Acknowledgments.....	iii
List of Tables	vii
List of Appendices.....	vii
Synopsis.....	1
Chapter 1 Introduction	3
1.1 Peripheral Arterial Disease.....	3
1.2 Epidemiology of PAD.....	4
1.3 Risk Factors	4
1.4 Anatomical Distribution of Peripheral Arterial Disease	5
1.5 Clinical presentation of peripheral arterial disease	6
1.6 Outcomes of PAD.....	8
1.7 Diagnosis of peripheral arterial disease.....	9
1.7.1 Non-invasive screening methods for PAD	9
1.7.1.1 Ankle Brachial Index.....	10
1.7.1.2 Toe Pressures	11
1.7.1.3 Toe Brachial Index.....	12
1.7.1.4 Continuous Wave Doppler Ultrasound	12
1.7.2 Non-invasive vascular assessment in Podiatry practice.....	14
1.8 Management of PAD	15
1.9 Aims of thesis.....	16
1.10 Objectives of Thesis.....	17
Chapter 2 A systematic review of the sensitivity and specificity of the toe-brachial index for detecting peripheral arterial disease.....	17
2.1 Preface.....	17
2.2 Authors.....	18
2.3 Abstract.....	19
2.3.1 Objectives	19
2.3.2 Methods.....	19
2.3.3 Results.....	19
2.3.4 Conclusions	19
2.4 Introduction	20
2.5 Materials and Methods	21
2.5.1 Search strategy	21
2.5.2 Inclusion and exclusion criteria	22
2.5.3 Study selection and data extraction.....	22
2.6 Results	23
2.6.1 Characteristics and overview of included studies	24
2.6.1.1 General	24
2.6.1.2 TBI Method	27
2.6.1.3 Quality Assessment.....	27
2.6.1.4 Sensitivity and specificity of the TBI.....	29
2.7 Discussion	29
2.7.1 Limitations	32
2.8 Conclusions.....	33
2.9 Acknowledgements.....	33
2.10 Conflict of interest statement.....	33
Chapter 3 The sensitivity and specificity of the toe-brachial index in detecting peripheral arterial disease: initial findings.....	33
3.1 Preface.....	33
3.2 Authors.....	34

3.3	Abstract.....	35
3.4	Introduction	36
3.5	Methods	37
3.6	Results	40
3.7	Discussion	42
3.7.1	Potential Limitations.....	45
3.8	Conclusion.....	45
Chapter 4 Non-invasive vascular assessment in the foot with diabetes: sensitivity and specificity of the ankle brachial index, toe brachial index and continuous wave Doppler in detecting peripheral arterial disease		46
4.1	Preface	46
4.2	Authors.....	47
4.3	Abstract.....	47
4.3.1	Background & Aims	47
4.3.2	Methods.....	48
4.3.3	Results.....	48
4.3.4	Conclusions	48
4.4	Introduction	48
4.5	Methods	50
4.6	Results	54
4.7	Discussion	58
4.7.1	Potential Limitations.....	60
4.8	Conclusion.....	61
4.9	Acknowledgements.....	61
Chapter 5 Vascular assessment techniques of podiatrists in Australia and New Zealand: A web-based survey		61
5.1	Preface	61
5.2	Authors.....	62
5.3	Abstract.....	63
5.3.1	Background.....	63
5.3.2	Methods.....	63
5.3.3	Results.....	63
5.3.4	Conclusion	64
5.4	Introduction	64
5.5	Methods	65
5.5.1	Data Analysis.....	66
5.6	Results	67
5.6.1	Participant Characteristics.....	67
5.6.2	Indicators to Perform a Vascular Assessment.....	67
5.6.3	Vascular Assessment Methods.....	71
5.6.4	Barriers in performing vascular assessment.....	74
5.6.5	Patient education.....	75
5.7	Discussion	75
5.7.1	Potential limitations.....	77
5.8	Conclusion.....	77
5.8.1	Acknowledgments.....	78
Chapter 6 Use of hand-held Doppler ultrasound examination by Podiatrists: A reliability study		78
6.1	Preface	78
6.2	Authors.....	79
6.3	Abstract.....	80
6.3.1	Background.....	80
6.3.2	Methods.....	80

6.3.3	Results.....	80
6.3.4	Conclusions.....	81
6.4	Introduction.....	81
6.5	Design and Methods.....	83
6.5.1	Raters.....	83
6.5.2	Participants.....	84
6.5.3	Procedure.....	84
6.5.4	Inter- and intra- rater reliability of Doppler use.....	85
6.5.5	Inter- and intra-rater reliability of Doppler audio interpretation.....	86
6.5.6	Inter- and intra-rater reliability of visual Doppler waveform interpretation..	87
6.5.7	Data Analysis.....	87
6.6	Results.....	88
6.6.1	Inter- and intra-rater reliability of Doppler use.....	88
6.6.2	Inter- and intra-rater reliability of Doppler audio interpretation.....	91
6.6.3	Inter- and intra-rater reliability of visual Doppler waveform interpretation..	91
6.7	Discussion.....	91
6.8	Conclusion.....	94
6.8.1	Acknowledgments.....	95
Chapter 7	Modified Method for Screening for Peripheral Arterial Disease.....	95
7.1	Preface.....	95
7.2	Authors.....	96
7.3	Abstract.....	97
7.3.1	Background.....	97
7.3.2	Method.....	97
7.3.3	Results.....	97
7.3.4	Conclusion.....	98
7.4	Introduction.....	98
7.5	Method.....	99
7.5.1	Experimental Procedure.....	101
7.6	Results.....	102
7.7	Discussion.....	103
7.7.1	Limitations.....	105
7.8	Conclusion.....	105
Chapter 8	Conclusion.....	106
8.1	Strengths & Limitations.....	108
8.2	Recommendations and directions for future research.....	113
8.3	Concluding statement.....	114
References	115

List of Figures

Figure 1.1	A depiction of a normal artery and an artery affected by atherosclerosis {Institute, 2011 #376}.....	3
Figure 1.2:	Relative Risk of PAD in relation to risk factors{Dormandy, 1999 #225}.....	5
Figure 1.3	Association of risk factor with pattern of atherosclerotic lesions {Diehm, 2006 #88}.....	6
Figure 1.4:	A foot affected by gangrene.....	8
Figure 1.5	An ankle pressure being measured.....	10
Figure 1.6:	A toe pressure being measured.....	12
Figure 1.7:	Triphasic Doppler waveform in posterior tibial artery.....	14
Figure 2.1	Search Strategy.....	24
Figure 2.2:	QUADAS-2 Risk of bias tool.....	28
Figure 3.1:	ROC analysis ABI vs TBI.....	42

Figure 4.1: ROC Analysis of TBI and ABI for detecting PAD in people without diabetes	57
Figure 4.2: ROC Analysis of TBI and ABI for detecting PAD in people with diabetes	58
Figure 5.1 Clinical indicators to prompt podiatrists to perform vascular assessment.....	68
Figure 5.2 Clinical testing performed by podiatrists.....	72
Figure 6.1 Flow chart.....	85
Figure 7.1 Flow chart of targeted screening method	100

List of Tables

Table 2.1: Search terms.....	22
Table 2.2: Summary of studies for sensitivity and specificity of the TBI for detecting PAD.....	26
Table 2.3: Risk of bias of included studies using QUADAS-2 tool.....	29
Table 3.1: Participant Characteristics.....	40
Table 3.2: Table of results.....	41
Table 4.1 Participant Characteristics.....	54
Table 4.2 Validation Table All Groups	56
Table 5.1 Survey Participant Characteristics.....	67
Table 5.2 General Vascular Assessment Information.....	68
Table 5.3 Clinical Indicators for Vascular Assessment	70
Table 5.4 Types of Testing Utilised by Podiatrists	73
Table 6.1: Participant demographics	88
Table 6.2: Reliability results for use of Doppler examination	90
Table 6.3: Reliability results of audio interpretation of Doppler	91
Table 6.4: Reliability results of visual Doppler waveform interpretation.....	91
Table 7.1: Participant Characteristics.....	103
Table 7.2: Results Table.....	103

List of Appendices

Appendix 1: Manuscript 1
Appendix 2: Advertising for TBI project
Appendix 3: Consent form for TBI project
Appendix 4: Authority to release healthcare information for TBI project
Appendix 5: Information statement for TBI project
Appendix 6: Ethics approval for TBI project
Appendix 7: Manuscript 2
Appendix 8: Manuscript 3
Appendix 9: Advertising Survey
Appendix 10: Survey
Appendix 11: Ethics approval survey
Appendix 12: Manuscript 4
Appendix 13 Consent form Doppler study
Appendix 14: Information statement Doppler study
Appendix 15 Ethics approval Doppler study
Appendix 16: Manuscript 5
Appendix 17: Manuscript 6
Appendix 18: Meta-analysis data

Synopsis

This thesis provides an examination of the current evidence base regarding the diagnostic accuracy of non-invasive vascular assessment examination of the lower limb. This project comprised of a systematic review and a further four studies investigating the comparative diagnostic accuracy of non-invasive vascular assessment methods in cohorts at risk of peripheral arterial disease (PAD), the current vascular assessment techniques of Podiatrists in Australia and New Zealand and the reliability of continuous wave Doppler (CWD) assessment performed by Podiatrists. The results of these studies were then used to develop a modified method of lower limb vascular assessment designed to reduce the time burden of performing assessment in clinical practice. The diagnostic accuracy of this method for PAD was then compared to existing international guidelines.

Systematic review of studies investigating the diagnostic accuracy of the toe-brachial index (TBI) for detecting PAD, using diagnostic imaging as a reference standard, identified a lack of existing data. Furthermore, of the studies that have been done, we found that there are significant variations in TBI value used to indicate pathology, making results difficult to interpret. Additionally no studies had undertaken investigations of comparative diagnostic accuracy of the TBI and the more widely used ankle-brachial index (ABI) using a valid reference standard. Therefore undertaking a study evaluating the comparative diagnostic accuracy of the TBI and the ABI for detecting PAD was necessary. The diagnostic accuracy of the TBI and ABI were determined in a population at risk of PAD and demonstrated the TBI was a better clinical tests for PAD while the ABI was highly likely to fail to detect the presence of disease.

As vascular assessment is also known to be particularly challenging in diabetes cohorts due to the specific clinical presentation of diabetes related PAD. Therefore a case-control diagnostic accuracy study of the ABI, TBI and CWD for diagnosing PAD was performed.

Compared to a control group, all tests had lower sensitivity in the group with diabetes with CWD superior diagnostic accuracy in both cohorts.

To further explore the nature of lower limb vascular assessment in clinical Podiatry practice a survey of self-reported lower limb vascular screening techniques used by Podiatrists in Australia and New Zealand was undertaken. From this survey, poor alignment of clinical assessment techniques with existing international guidelines was identified. The most commonly employed vascular assessment techniques used by Podiatrists was reported to be CWD using hand-held Doppler while lack of time was reported to be a significant barrier to undertaking objective vascular assessment tests in clinical practice. As a result of these findings, an inter and intra-tester reliability study of hand-held Doppler examination by performed by Podiatrists was undertaken. This showed that the inter and intra-tester reliability of clinical Doppler examination by podiatrists is low and therefore likely to be of limited value for ongoing monitoring of lower limb vascular function.

Finally, using the research completed in this thesis combined with the current evidence base, a modified lower limb vascular screening method was devised. The diagnostic accuracy of this modified method for detecting PAD was then compared to the diagnostic accuracy of current international guidelines (American Heart Association Guidelines). This showed that the method had similar diagnostic accuracy to the current guideline, however may be more time effective.

The studies presented in this thesis re-enforce the difficulties with non-invasive vascular assessment of the lower limb, particularly in diabetes. The studies also demonstrate that the TBI has good clinical applicability and has good diagnostic accuracy and therefore may be a screening test of choice in populations at risk of PAD.