

**Investigation of the effects of  
needling the acupuncture point  
Houxi (SI 3) on pressure pain  
threshold, needling sensation and  
needling pain in healthy  
participants**

---

A THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF  
PHILOSOPHY

Xiaoqin Wu BMed (BUCM), MMedSc (BUCM).  
FACULTY OF SCIENCE | UNIVERSITY OF TECHNOLOGY  
SYDNEY 2021

## CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Xiaoqin Wu declare that this thesis, is submitted in fulfilment of the requirements for the award of the Doctor of Philosophy, in the School of Life Sciences in the Faculty of Sciences at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

This research is supported by an Australian Government Research Training Program Scholarship.

Production Note:

Signature: Signature removed prior to publication.

Date: 26/06/2021

## **Acknowledgements**

Time flies, four years of my Ph. D candidate life will soon come to an end. I still remember my excitement when I came to the University of Technology Sydney in the autumn of 2017. The past four years are full of many wonderful memories, and certainly I have experienced many difficulties and setback. It is an inevitable process when I think about it now. Four years, sounds like a long time, but after all the study and life experience at UTS, it has been very short. As I approach the completion of my graduation thesis, I would like to sincerely thank many people.

First of all, I would like to thank my supervisory panel. My principal supervisor, Dr Shuai Zheng provided valuable advice for my research project. In particular, I would like to thank A/Prof Christopher Zaslowski, who has given me praise, encouragement and for standing by me. Chris has inspired me to conquer all the difficulties, especially in my data collection and the process of writing my thesis. He is my scientific development lamp, illuminating my research future. My co-supervisor, Prof Chi Eung Danforn Lim, helped me find the internship opportunity when I needed work experience. He always gives helpful comments to my thesis writing. Dr Yew Kian Loyeung, urged me to make more effort so that I could be proud of myself after the PhD training. They are knowledgeable, rigorous in academia, instructive and loving, and gave me a lot of care. What I learnt from my supervisors is not only knowledge, but also certain truths about life, which will benefit me for life.

During the three years of research study, Dr. Shohreh Razavy had taken special care of me both in data analysis and in thesis writing. She paved the way for me to accomplish this thesis. Dr. Seong Leang Cheah also provided guidance in my data analysis. I remember their help as a creed to guide my way forward.

I would like to express my sincere thanks to Dr Chunlin Zhou and all the teachers at the School of Life Sciences at UTS for their valuable opinions in the writing of my thesis. I would also like to thank Dr. Shengxi Zhang for teaching me that only by working hard can I live more calmly. Dr. Shuiqing Zhang helped me understand that research is also a very happy and satisfying thing. I also thank Ms. Hui You, Mr. Yoann Birling and Ms. Jing Wang who spared their valuable time for my data analysis. All teachers and my schoolfellows have given me a lot of help, inspired me to think about life. I really appreciate you!

I am also very grateful to all the participants in my research study whether they have fully or partially completed all sessions of the project. Without their patient and sincere support, the collection of a substantial amount of quality data would not be possible.

This work was supported by the Australian Postgraduate Awards under the scholarship scheme of Commonwealth Government, in conjunction with Australian universities. This 3 year award has provided great financial assistance and incentive to the completion of this thesis.

My gratitude also goes to the staff who have conducted various workshops in literature searching, EndNote, research ethics, data management and data analysis through the Graduate Research School and UTS Library. I have obtained a lot of research knowledge and skills.

Finally, I would also like to express my gratitude to my family, my relatives, and my friends for their encouragement and support towards the development and completion of this thesis during COVID-19 crisis. They have, on many occasions, expressed their concern, encouragement and understanding, and supported me to move on till the submission of this thesis.

*Remember tonight... for it is the beginning of always.*

## Abstract

**Background:** During the past decades, there has been a surge in prescribing opioids for pain related conditions, the “opioid epidemic”. It is critical for researchers and clinicians to explore other non-pharmacological approaches to manage pain instead of relying on opioid analgesics. Acupuncture could be an effective tool to modulate pain.

Since 1999, studies on the effect of acupuncture on pressure pain threshold (PPT), at the University of Technology Sydney (UTS), have been conducted. The effects of the acupuncture to the acupoint LI 4 (*Hegu*) on PPT, the strength and quality of needling sensation (*deqi*) and the intensity of needling pain have been investigated by researchers from the UTS acupuncture group. However, the effects of another acupoint, Small Intestine 3 (SI 3 -*Houxi*) a commonly used acupoint for the treatment of various pain-related conditions has not been explored for its effect on PPT and *deqi*.

**Aim:** The primary aim of this study was to investigate the effects of needling the acupoint SI 3 in healthy people on:

1. Regional PPT at ten sites (SI 11<sup>R</sup>, SI 11<sup>L</sup>, GV 4, GV 14, HT 7<sup>R</sup>, HT 7<sup>L</sup>, BL 60<sup>R</sup>, BL 60<sup>L</sup>, GB 21<sup>R</sup>, GB 21<sup>L</sup>) following three different interventions - SI3m<sup>+</sup>, SI3m<sup>-</sup> and SL;
2. The strength and quality of needling sensation (*deqi*) reported by subjects; and
3. The intensity of pain associated with the intervention.

**Methods:** Prior to commencing the study a systematic review was undertaken on the clinical use of acupoint SI 3 and PPT in acupuncture clinical studies. Following the reviews, this prospective study was designed as a randomised, double-blind, three-arm, and cross-over experimental study to investigate the effects of needling SI 3 on regional PPT, *deqi* and needling pain.

**Results:** For SI3m<sup>+</sup> and SI3m<sup>-</sup> interventions, the post intervention mean % PPT scores were significantly elevated compared with SL ( $p < 0.001$ ). SI3m<sup>+</sup> statistically significantly elevated PPT% comparing to SI3m<sup>-</sup> ( $p < 0.001$ ). The mean needle sensation and pain scores were similar for the two needling interventions, but both increased when comparing to SL. The subjects’ anxiety and tension levels were not significantly different across the interventions.

**Conclusions:** Both intervention and site of needling were found to be important contributors to the effects on regional PPT in healthy participants. This study has provided

findings that support the belief that obtaining *deqi* during acupuncture is necessary for eliciting a pain modulating effect. Needling pain had no correlation with PPT.

## Abbreviation List

ACR	American College of Rheumatology criteria
ADHD	Attention Deficit Hyperactivity Disorder
AIS	Adolescent Idiopathic Scoliosis
AMED	Allied and Complementary Medicine Database
AMT	Abbreviated Mental Test
ANDS	Australian National Data Service
ANOVA	Analysis of Variance
AT	Acupuncture Treatment
BCE	Before Common Era
BDI	Beck Depression Inventory
BI	Barthel Index
BIS	Baseline Index Score
BL	Bladder Meridian
BMed	Bachelor of Medicine
BMI	Body Mass Index
BFI	Brief Fatigue Inventory
BPI-SF	Brief Pain Inventory-Short Form
BUCM	Beijing University of Chinese Medicine
C	Cervical Vertebra
CA	Combined acupuncture which consists of traditional acupuncture and ear acupuncture
Ca <sup>2+</sup>	Calcium
CDT	Cold Detection Threshold
CES-D	Centre for Epidemiologic Studies–Depression Scale

CG	Control Group
CI	Confidence Intervals
cm	centimetre
CM	Chinese Medicine
CMD	Cranio-mandibular Disorders
CMI	Cornell Medical Index
CONSORT	Consolidated Standards of Reporting Trials
COVID-19	Coronavirus disease 2019
COX-2	Cyclooxygenase-2
CPT	Cold Pain Threshold
CPGS	Chronic Pain Grade Scale
CRF	Cancer-Related Fatigue
CS	Cervical Myofascial Syndrome
CSQ	Coping Strategies Questionnaire
CT	Connecticut
CV	Conception Vessel
CZ	Christopher Zaslowski
DLQI	Dermatology Life Quality Index
DN	Dry Needling
DNIC	Diffuse Noxious Inhibitory Control
DOMS	Delayed-Onset Muscle Soreness
EA	Electro acupuncture
EA	Ear Acupuncture
EASI	Eczema Area and Severity Index



ECG	Electrocardiography
EEG	Electro-encephalography
EIF	Education Investment Fund
EPT	Electrical Pain threshold
et al	and others
FACT-G	Functional Assessment of Cancer Therapy-General
FIM	Functional Independence Measure
FIQ	Fibromyalgia Impact Questionnaire
EMBASE	Excerpta Medica Database
FMA	Fugl-Meyer Assessment of Physical Performance
FMAM	Fugl-Meyer Assessment of Physical Performance—Motor subsection
fMRI	functional Magnetic Resonance Imaging
Ex	Extraordinary point
F	Female
FMS	Fibromyalgia Syndrome
FSS	Fatigue Severity Scale
f-TCD	functional Transcranial Doppler Sonography
fVAS	final Visual Analog Scales
GB	Gigabyte(s)
GB	Gallbladder Meridian
GLM	General Linear Model
GON	Gonarthrosis
GV	Governor Vessel
HF	Acupuncture with high-frequency electrical stimulation

HPT	Heat Pain Threshold
HREC	Human Research Ethics Committee
HT	Heart Meridian
IASP	International Association for the Study of Pain
IBM	International Business Machines Corporation
ICD-11	International Statistical Classification of Diseases and Related Health Problems 11th Revision
ICOAP	Intermittent and Constant Osteoarthritis Pain
ID	Identification
IL	Interleukin
iVAS	initial Visual Analog Scales
K <sup>+</sup>	Potassium
kg	Kilogram(s)
KI	Kidney Meridian
kPa	Kilopascal
KWOMAC	Korean translation of Western Ontario and McMaster Universities Osteoarthritis Index
L	Lumbar Vertebra
LBP	Lower Back Pain
LF	Acupuncture with low-frequency electrical stimulation
LI	Large Intestine Meridian
LR	Liver Meridian
LSS	Lumbar Spinal Stenosis
LTF	Lateral Trunk Flexibility
LU	Lung Meridian

M	Male
m	Metre(s)
MA	Manual Acupuncture
MASS	Massachusetts General Hospital Acupuncture Sensation Scale
MDI	Massachusetts General Hospital Acupuncture Sensation Scale <i>Deqi</i> index
MEDLINE	on-line Medical Literature Analysis and Retrieval System
MGH	Massachusetts General Hospital
MGPQ	McGill Pain Questionnaire
MIG	Migraine
MIVF	Maximum Isometric Voluntary Force
mm	Millimetre
MMedSc	Master of Medical Sciences
MNS-PC6	Median Nerve Stimulation through Acupuncture Needles at the PC 6 ( <i>Neiguan</i> ) Acupoint
MPS	Myofascial Pain Syndrome
MPT	Mechanical Pain Threshold
MRI	Magnetic Resonance Imaging
MYMOP-2	Measure Yourself Medical Outcome Profile
NAP	Nonacupoint
NDI	Neck Disability Index
NG	NICE guideline
NHMRC	National Health and Medical Research Council
NHP	Nottingham Health Profile
NICE	National Institute for Health and Care Excellence

NIHSS	National Institutes of Health Stroke Scale
NM	Naturopathic Medicine
NPQ	Northwick Park Questionnaire
NPSA	Nonpenetrating Sham Acupuncture
NRS	Numeric Rating Scale
NSAIDs	Non-Steroidal Anti-inflammatory Drugs
OIRD	Opioid-induced Respiratory Depression
PA	Placebo Acupuncture
PC	Pericardium Meridian
PEDro	Physiotherapy Evidence Database
PET	Positron Emission Tomography
Ph. D	Doctor of Philosophy
POEM	Patient Oriented Eczema Measure
PPT	Pressure Pain Threshold
PS	Pain Scores
qEEG	Quantitative Electroencephalography
QOL	Quality of Life
QST	Quantitative Sensory Testing
RA	Rheumatoid Arthritis
RA	Real Acupuncture
RCT	Randomised Controlled Trial
RMDQ	Roland-Morris Disability Questionnaire
ROM	Range of Motion
s	Second

SA	Sham Acupuncture
SASS	Subjective Acupuncture Sensation Scale
SC	State-of-the-art Specialty Care
SCI	Spinal Cord Injury
SCORAD	SCORing Atopic Dermatitis
SDS	Self-Rating Depression Scale
SF-36	Short Form-36
SF-36 BPS	Short Form-36 Bodily Pain Scale
SF-36v2 MCS	Short Form 36 version 2 health survey, mental component
SF-36v2 PCS	Short Form-36 version 2 health survey, physical component
SF-MPQ	Short-Form McGill Pain Questionnaire
SI	Small Intestine Meridian
SI3m <sup>+</sup>	Manual acupuncture to SI 3 with manipulation
SI3m <sup>-</sup>	Manual acupuncture to SI 3 without manipulation
Sig.	Significance level
SIS	Shoulder Impingement Syndrome
SL	Sham Laser
SMT	Spinal Manipulative Therapy
SP	Spleen Meridian
SPADI	Shoulder Pain and Disability Index
SPECT	Single Photon Emission Computed Tomography
SPIRIT	Standard Protocol Items: Recommendations for Interventional Trials
SPSS	Statistical Package for the Social Sciences
STAXI	State-Trait Anger Expression Inventory

STRICTA	Standards for Reporting Interventions in Clinical Trials of Acupuncture
T	Thoracic Vertebra
TA	True Acupuncture
TCA	Traditional Chinese Acupuncture
TCM	Traditional Chinese Medicine
TE	Triple Energizer Meridian
TENS	Transcutaneous Electric Nerve Stimulation
TG	Test Group
TMDs	Temporomandibular Joint Disorders
TTH	Tension-Type Headache
TTM	Thai Traditional Massage
TUG	Timed Up and Go Test
UCLA	University of California, Los Angeles
UE	Upper-Extremity
UK	United Kingdom
USA	United States of America
USB	Universal Serial Bus
UTS	University of Technology Sydney
VA	Verum Acupuncture
VAS	Visual Analog Scales
WAD	Whiplash-Associated Disorders
WDT	Warm Detection Threshold
WOMAC	Western Ontario and McMaster Universities Osteoarthritis Index
XQW	Xiaoqin Wu

YNSA

Yamamoto New Scalp Acupuncture

## Supporting communications and publications

Paper oral presentation:

**Wu, XQ., Loyeung, Y. K., Lim, C. E. D. & Zaslowski, C. J.** 2019. “Investigating the effects of the acupuncture point SI 3 (*Houxi*) on pressure pain threshold, needling sensation and needling pain in healthy participants”, The 5th American TCM Congress, The 3rd Annual Symposium by UCLA Center for East-West Medicine, 4-6<sup>th</sup> October 2019, Los Angeles, USA.

**Wu, XQ., Loyeung, Y. K., Lim, C. E. D. & Zaslowski, C. J.** 2019. “Investigating the effects of the acupuncture point SI 3 (*Houxi*) on pressure pain threshold, needling sensation and needling pain in healthy participants”, The 5th International Traditional Chinese Medicine Symposium, 9-10<sup>th</sup> November 2019, Sydney, Australia.

**Wu, XQ., Loyeung, Y. K., Lim, C. E. D. & Zaslowski, C. J.** 2019. “Investigating the effect of acupuncture point SI 3 on pressure pain threshold, needling sensation and psychology in healthy participants”, The 6th International Psychology Conference of Traditional Chinese Medicine & The 4th General Election Meeting, 15-17<sup>th</sup> November 2019, Beijing, China.

Public Speech and media interview:

Taking Science to your local library for Sydney Science Festival, “From Empirical Medicine to Experimental Medicine”, 15 August 2018.

SBS interview: <https://www.sbs.com.au/language/english/audio/sydney-science-festival-wuxiaoqin-interview>



## Contents

Acknowledgements .....	ii
Abstract .....	iv
Abbreviation List .....	vi
Supporting communications and publications .....	xv
Tables .....	xx
Figures.....	xxi
Chapter 1: Introduction .....	1
Study aims .....	3
Significance of the project.....	5
Thesis structure.....	5
Chapter 2: Background .....	7
2.1 Pain.....	7
2.1.1 Pain definition and physiology .....	7
2.1.2 Pain classifications.....	7
2.1.3 Pain epidemiology .....	8
2.1.4 Conventional pain treatment.....	8
2.1.5 Other naturopathic approaches for pain modulation.....	12
2.2 Acupuncture to pain treatment .....	12
2.2.1 Definition.....	12
2.2.2 Traditional Chinese acupuncture theory .....	13
2.2.3 Neurobiological mechanisms of action.....	14
2.2.4 Safe .....	16
2.2.5 Indications.....	17
2.3 Location of SI 3 according to classical textbooks .....	17
2.4 Location of SI 3 according to modern textbooks .....	19
2.5 Neuroanatomical and stratified anatomical catalog of SI 3.....	22
2.6 Explanation of the name .....	22
2.7 Applications of SI 3 according to classical textbooks.....	24
2.8 Applications of SI 3 according to modern textbooks .....	24
2.9 SI 3 for pain relief from a Chinese Medicine perspective.....	26
Chapter 3: Systematic literature review .....	27
3.1 The application of SI 3 ( <i>Houxi</i> ) for pain as reported in randomised controlled trials: a systematic review .....	27
3.1.1 Methods .....	27

3.1.2 Results.....	29
3.1.3 Discussion.....	75
3.1.4 Conclusion .....	76
3.2 Application of pressure pain threshold in acupuncture clinical study: a systematic review of randomised controlled trials .....	77
3.2.1 Introduction.....	77
3.2.2 Objective.....	78
3.2.3 Methods .....	79
3.2.4 Results.....	80
Chapter 4: Methods: a protocol for a randomised controlled study.....	116
4.1 Study design .....	116
4.2 Protocol Version.....	118
4.3 Research team roles and responsibilities.....	118
4.4 Background and rationale.....	118
4.5 Study setting .....	119
4.6 Participants .....	120
4.7 Sample size.....	120
4.8 Recruitment .....	120
4.9 Eligibility criteria .....	121
4.9.1 Inclusion criteria .....	121
4.9.2 Exclusion criteria .....	121
4.10 Randomization and allocation .....	123
4.10.1 Sequence generation .....	123
4.10.2 Allocation concealment mechanism .....	123
4.10.3 Implementation .....	124
4.11 Blinding (masking).....	124
4.12 Data collection, management, and analysis.....	125
4.12.1 Primary measures.....	125
4.12.2 Additional measures relating interventions .....	125
4.12.3 Participants' retention .....	128
4.12.4 Data management (see Appendix 9):.....	128
4.12.5 Statistical methods .....	128
4.13 Intervention .....	130
4.13.1 Protocol.....	130
4.13.2 Procedure – approximately 60 minutes .....	131

4.13.3 Intervention protocol.....	132
4.14 Outcome .....	134
4.14.1 Primary subjective outcome measure .....	135
4.14.2 Additional subjective outcome measures relating interventions .....	140
4.15 Participant timeline: .....	141
4.16 Ethics and dissemination .....	144
4.17 Summary .....	144
Chapter 5 Results of a prospective crossover trial .....	145
5.1 Characteristics of participants .....	145
5.2 Variation depending on PPT .....	145
5.2.1 PPT measurements.....	146
5.2.2 Homogeneity test of variance .....	146
5.2.3 To compare and contrast the effects on PPT of three interventions .....	147
5.2.4 Nonparametric test.....	153
5.3 Comparison of the effects on needling pain intensity scores among the three interventions to the acupoint SI 3 .....	155
5.3.1 Needling pain (VAS) in three different interventions without differentiating gender.....	155
5.3.2 Needling pain (VAS) in three different interventions according to gender..	157
5.3.3 Nonparametric test for needling pain.....	158
5.4 To compare and contrast the effects on needling sensation ( <i>deqi</i> ) of three interventions to the acupoint SI 3 .....	159
5.4.1 VAS needling sensation ( <i>deqi</i> ) scores .....	159
5.4.2 MASS <i>deqi</i> Index (MDI) .....	163
5.5 Other perceptions .....	164
5.5.1 How did you feel during the treatment? .....	164
5.5.2 Were you anxious about feeling pain from the intervention today?.....	166
5.6 Correlation amongst PPT, needling pain and <i>deqi</i> .....	168
5.6.1 Correlation between PPT and needling pain.....	168
5.6.2 Correlation between PPT and <i>deqi</i> .....	171
5.6.2.1 Correlation between PPT and <i>deqi</i> VAS .....	171
5.6.2.2 Correlation between PPT and MDI .....	174
Chapter 6: Discussion and implications .....	187
6.1 Introduction .....	187
6.2 Systematic reviews' key findings .....	187

6.3 Methodological discussion .....	188
6.4 Overview and summary of findings from the trial .....	189
6.5 Strengths of the Trial .....	192
6.6 Implications for Chinese medical theory.....	192
6.7 Implications for practice.....	194
6.8 Limitations of the current study .....	194
6.9 Recommendations for future research.....	195
Chapter 7: Conclusion.....	197
Clinical Significance .....	198
Reference List .....	199
Appendices.....	221
Appendix 1. Criteria for the PEDro Scale .....	222
Appendix 2. SPIRIT 2013 Checklist: Recommended Items to Address in a Clinical Trial Protocol and Related Documents .....	224
Appendix 3. Research Team Roles and Responsibilities .....	230
Appendix 4. Participant Information Sheet and Consent Form .....	232
Appendix 5. Script for Subjects' Recruitment .....	237
Appendix 6. Random Number.....	238
Appendix 7. Incident Adverse Reaction Harms Reporting Form .....	239
Appendix 8. Questionnaires & Data Collection Forms.....	240
Appendix 9. Data Management Plan.....	245
Appendix 10. Registration Form .....	248
Appendix 11. Procedure of Participation .....	250
Appendix 12. Criteria for Discontinuing or Modifying Allocated Interventions for a Given Trial Participant .....	251
Appendix 13. Strategies to Improve Adherence to Intervention Protocols, and Any Procedures for Monitoring Adherence .....	252
Appendix 14. Relevant Concomitant Care and Interventions that Are Permitted or Prohibited during the Trial .....	253
Appendix 15. Monitoring & Harms .....	254
Appendix 16. Ethics and Dissemination .....	256
Appendix 17. Project Change Management Form .....	258
Appendix 18. Explanations of Technical Terms Used.....	259
Appendix 19. Standard Operating Procedures .....	260
Appendix 20. Examine Variable of Mean Percentage Change of PPT by Intervention .....	265

Appendix 21: Tests of Between-subjects Effects .....	268
Appendix 22. Multiple Comparisons .....	269
Appendix 23. Examine Variable of Mean Percentage Change of PPT by Site.....	270
Appendix 24. Nonparametric Tests .....	275
Appendix 25. Tests of Between-subjects Effects of Needling Pain VAS.....	277
Appendix 26. Nonparametric Test of Needling Pain VAS .....	278

## Tables

Table 2.1: Range of pain treatments.....	9
Table 2.2 Descriptions of SI 3 anatomical location according to three classical textbooks .....	19
Table 2.3: A cross-text comparison of the operational definitions of acupoint SI 3 .....	21
Table 2.4: Neuroanatomical and stratified anatomical substrate of SI 3 .....	23
Table 2.5: Application of SI 3 according to classical textbooks.....	24
Table 2.6: SI 3 combined with additional acupoints.....	25
Table 3.1: Characteristics of the included studies (1).....	32
Table 3.2: Characteristics of the included studies (2).....	60
Table 3.3: Acupuncture RCTs using PPT measurement (1) .....	83
Table 3.4: Acupuncture RCTs using PPT measurement (2) .....	93
Table 4.1: Schedule of enrolment, interventions, and assessments .....	1344
Table 4.2: Description of the anatomical location of the ten measurements sites .....	139
Table 5.1: Characteristics of healthy subjects.....	145
Table 5.2: Mean percentage change in PPT from pre intervention mean (baseline) for the three interventions.....	147
Table 5.3: Between intervention scores and significance levels for mean %PPT (en bloc).....	149
Table 5.4: Mean percentage change in PPT from pre intervention mean at the ten regional measurement sites for the three SI 3 interventions .....	150
Table 5.5: Comparison of the mean percentage change in PPT .....	153
Table 5.6: Levene's test of equality of error variance .....	154
Table 5.7: Nonparametric tests hypothesis test summary by interventions.....	154
Table 5.8: Related-samples Friedman's two-way analysis of variance.....	154
Table 5.9 Mean % PPT pairwise comparisons by interventions.....	155
Table 5.10: Needling pain scores (VAS).....	156
Table 5.11: Needling pain scores (VAS) by gender .....	<b>Error! Bookmark not defined.</b> 6
Table 5.12: Multiple comparisons of needling pain VAS.....	157
Table 5.13: Mean needling pain (VAS) concerning gender.. ..	1588
Table 5.14: Levene's test of equality of error of needling pain VAS variances .....	1609
Table 5.15: Mean scores of needling sensation (VAS).....	16360
Table 5.16: Mean score of needling sensation (VAS) by gender .....	161
Table 5.17: Comparison of mean VAS for needling sensation ( <i>deqi</i> ) of the three needling interventions.....	162

Table 5.18: Comparison of mean VAS for needling sensation ( <i>deqi</i> ) of the three needling interventions by gender .....	162
Table 5.19: Levene's test of equality of error variances of <i>deqi</i> (VAS) .....	162
Table 5.20: Mean scores of MDI .....	163
Table 5.21: Comparison of mean MDI for the three needling interventions by gender.....	164
Table 5.22: Levene's test of equality of MDI error variances.....	164
Table 5.23: Descriptive statistics of feeling tense.....	165
Table 5.24: Levene's test of equality of error variances of “feeling tense” .....	166
Table 5.25: Analysis of Mean VAS scores regarding “feeling tense” during the three needling interventions .....	166
Table 5.26: Descriptive statistics of anxiety feeling during the three interventions.....	167
Table 5.27: Homogeneity of variance anxiety feeling.....	167
Table 5.28: Correlations between PPT and needling pain by two acupuncture interventions.....	169
Table 5.29: Correlations between PPT and needling pain by acupuncture intervention without manipulation .....	170
Table 5.30: Correlations between PPT and needling pain by acupuncture intervention with manipulation.....	171
Table 5.31: Correlations between PPT and <i>deqi</i> VAS by two acupuncture interventions.. .....	172
Table 5.32: Correlations between PPT and <i>deqi</i> VAS by SI3m <sup>-</sup> .....	173
Table 5.33: Correlation between PPT and <i>deqi</i> VAS by SI3m <sup>+</sup> .....	174
Table 5.34: Correlations between PPT and MDI by two acupuncture interventions... ..	175
Table 5.35: Correlations between PPT and MDI by SI3m <sup>-</sup> .....	176
Table 5.36: Correlations between PPT and MDI by SI3m <sup>+</sup> .....	177
Table 5.37: Correlations between needling pain and <i>deqi</i> VAS by two acupuncture interventions - SI3m <sup>-</sup> , SI3m <sup>+</sup> .....	178
Table 5.38: Correlations between needling pain and <i>deqi</i> VAS by acupuncture intervention - SI3m <sup>-</sup> .....	179
Table 5.39: Correlations between needling pain and <i>deqi</i> VAS by acupuncture intervention - SI3m <sup>+</sup> .....	180
Table 5.40: Correlations between needling pain and MDI by SI3m <sup>-</sup> and SI3m <sup>+</sup> .....	181
Table 5.41: Correlations between needling pain and MDI by SI3m <sup>-</sup> .....	182
Table 5.42: Correlations between needling pain and MDI by SI3m <sup>+</sup> .....	183
Table 5.43: Correlations between MDI and <i>deqi</i> VAS by SI3m <sup>-</sup> and SI3m <sup>+</sup> .....	184
Table 5.44: Correlations between MDI and <i>deqi</i> VAS by SI3m <sup>-</sup> .....	185
Table 5.45: Correlations between MDI and <i>deqi</i> VAS by SI3m <sup>+</sup> .....	186

## Figures

Figure 2.1: Rat and human maps of acupoints used in pain studies .....	17
Figure 2.2: Location of SI 3 .....	22
Figure 3.1: PRISMA flow chart of literature searching and article selection process....	31
Figure 3.2: Fifteen countries of origin .....	71
Figure 3.3: Frequency distribution of the modified Jadad's scale scores .....	72
Figure 3.4: Unilateral or bilateral needling of SI 3 .....	72
Figure 3.5: Needling retention time .....	73
Figure 3.6: Needle sensation ( <i>deqi</i> ) on SI 3 location.....	73

Figure 3.7: Type of pain conditions treated in clinical trials involving the use of SI 3...	74
Figure 3.8: Number and frequency of treatments for the 56 clinical trials .....	75
Figure 3.9: Effective for pain relief.....	75
Figure 3.10: PPT RCTs literature review PRISMA flow chart	<b>Error! Bookmark not defined.2</b>
Figure 4.1: Study schedule.....	117
Figure 4.2: The 100mm VAS used to record subject perceptions relating to the 21 min intervention period for each experimental session.....	126
Figure 4.3: MASS data collection form .....	127
Figure 4.4: Lie prone position.....	131
Figure 4.5: Location of GV 4.....	135
Figure 4.6: Location of GV 14.....	136
Figure 4.7: Location of SI 11. ....	136
Figure 4.8: Location of GB 21. ....	137
Figure 4.9: Location of HT 7 .....	137
Figure 4.10: Location of BL 60 .....	138
Figure 4.11: Wagner FPK Algometer .....	140
Figure 4.12: Diagram showing flow of participants .....	143
Figure 5.1: A boxplot for mean percentage %PPT change from pre intervention scores for the three interventions from pre-intervention scores.....	1488
Figure 5.2: Mean percentage change in PPT from pre intervention for the ten regional sites by SI3m <sup>-</sup> .....	<b>Error! Bookmark not defined.1</b>
Figure 5.3: Mean percentage change in PPT from pre intervention for the ten regional sites by SI3m <sup>+</sup> .....	<b>Error! Bookmark not defined.1</b>
Figure 5.4: Mean percentage change in PPT from pre intervention for the ten regional sites by SL.....	<b>Error! Bookmark not defined.2</b>
Figure 5.5: Means of needling pain (VAS) for the three different interventions without differentiating gender .....	1577
Figure 5.6: Means scores of needling pain (VAS) for the three different interventions by gender.....	15858
Figure 5.7: Means of <i>deqi</i> VAS .....	16060
Figure 5.8: Means of <i>deqi</i> VAS by genders.....	<b>Error! Bookmark not defined.1</b>
Figure 5.9: Mean MDI scores of the three interventions	<b>Error! Bookmark not defined.63</b>
Figure 5.10: Mean VAS score concerning “feeling tense” during the three needling interventions.....	165
Figure 5.11: Mean score concerning anxiety feeling during the three needling interventions.....	167
Figure 5.12: Scatterplots of relationship between PPT and needling pain by two different acupuncture interventions .....	168
Figure 5.13: Scatterplots of relationship between PPT and needling pain by acupuncture intervention without manipulation .....	169
Figure 5.14: Scatterplots of relationship between PPT and needling pain by acupuncture intervention with manipulation .....	170
Figure 5.15: Scatterplots of relationship between PPT and <i>deqi</i> VAS by SI3m <sup>-</sup> and SI3m <sup>+</sup> .....	172

Figure 5.16: Scatterplots of relationship between PPT and <i>deqi</i> VAS by SI3m <sup>-</sup> .....	173
Figure 5.17: Scatterplots of relationship between PPT and <i>deqi</i> VAS by SI3m <sup>+</sup> .....	174
Figure 5.18: Scatterplots of relationship between PPT and <i>deqi</i> MDI in two acupuncture interventions.....	175
Figure 5.19: Scatterplots of relationship between PPT and MDI by SI3m <sup>-</sup> .....	176
Figure 5.20: Scatterplots of relationship between PPT and MDI by SI3m <sup>+</sup> .....	177
Figure 5.21: Scatterplots of relationship between needling pain and <i>deqi</i> VAS by acupuncture interventions - SI3m <sup>-</sup> , SI3m <sup>+</sup> .....	178
Figure 5.22: Scatterplots of relationship between needling pain and <i>deqi</i> VAS by acupuncture intervention - SI3m <sup>-</sup> .....	179
Figure 5.23: Scatterplots of relationship between needling pain and <i>deqi</i> VAS by acupuncture intervention - SI3m <sup>+</sup> .....	180
Figure 5.24: Scatterplots of relationship between needling pain and MDI by SI3m <sup>-</sup> and SI3m <sup>+</sup> interventions.....	181
Figure 5.25: Scatterplots of relationship between needling pain and MDI by SI3m <sup>-</sup> intervention.....	182
Figure 5.26: Scatterplots of relationship between needling pain and MDI by SI3m <sup>+</sup> intervention.....	183
Figure 5.27: Scatterplots of relationship between MDI and <i>deqi</i> VAS by SI3m <sup>-</sup> and SI3m <sup>+</sup> intervention.....	184
Figure 5.28: Scatterplots of relationship between MDI and <i>deqi</i> VAS by SI3m <sup>-</sup> .....	185
Figure 5.29: Scatterplots of relationship between MDI and <i>deqi</i> VAS by SI3m <sup>+</sup> .....	186