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**THE EFFECT OF SOFT TISSUE MOBILIZATION
TECHNIQUES ON THE SYMPTOMS OF CHRONIC
POSTERIOR COMPARTMENT SYNDROME IN RUNNERS: A
MULTIPLE CASE STUDY APPROACH**

by

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ABSTRACT

TITLE	The effect of soft tissue mobilization techniques on the symptoms of chronic posterior compartment syndrome in runners: A multiple case study approach.
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Chronic posterior compartment syndrome (CPCS) of the leg is a pathological condition which is often encountered by participants in exercise related activities such as running. To date no successful conservative treatment approach existed for the condition. The mainstay of the management of the condition at present is the surgical release of the involved fascia that surrounds the compartment. The main aim of the research project was thus to develop a successful conservative treatment approach for the symptoms of CPCS. It was identified that the current theoretical base did not incorporate the continuous and relatively inelastic nature of the fascia which plays an important role in the condition. Based on an extended literature review, muscles which are linked to the posterior compartment via the myofascial tissue were identified. Tightness in these *clinically significant* muscles is able to induce stresses in the myofascial chain which could ultimately influence stresses in the posterior compartment of the leg. The release of tightness in these muscles external to the posterior compartment through soft tissue mobilization techniques provides an effective conservative treatment approach for the symptoms of CPCS. A revised model for the pathogenesis of CPCS was developed which formed the basis for treatment interventions. The revised theoretical model for the pathogenesis of CPCS was validated based on a mixed-methodological approach which included a series of exploratory as well as explanatory case studies. This qualitative approach was supplemented by quantitative experiments in which the causal relationships of the condition on certain biomechanical aspects were explored. The treatment



interventions had a hundred percent success rate and the results of the experimental research conducted also supports the new theoretical model for the pathogenesis of CPCS.

Key words:

Chronic Posterior Compartment Syndrome; Pathogenesis; Fascia; Soft tissue myofascial links; Soft tissue mobilization techniques; Conservative interventions; Connective tissue; Running injuries; Qualitative research paradigms; Mixed-methodologies; Alternatives to surgical management.



OPSOMMING

TITEL	Die invloed van sagteweefsel mobiliseringstegnieke op die simptome van kroniese posterior kompartementsindroom in hardlopers: ‘n Meervoudige gevallestudie benadering
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Kroniese posterior kompartementsindroom (KPKS) van die onderbeen is ‘n patologiese toestand wat ervaar word deur persone wat aan oefeningsverwante aktiwiteite soos hardloop deelneem. Daar bestaan tans geen suksesvolle konserwatiewe behandeling vir die sindroom nie. Die enigste huidige aanbevole behandeling is die chirurgiese loslating of verwydering van die fascia rondom die simptomatiese kompartement. Die hoofdoel van hierdie studie was dus om ‘n suksesvolle konserwatiewe behandelingsregime vir die behandeling van die simptome van KPKS te ontwikkel. Daar is bevind dat die huidige teoretiese grondslag vir die behandeling van die toestand nie die kontinuïteit en die onelastisiteit van die fascia netwerk, wat ‘n groot rol in die sindroom speel, in ag neem nie. Spiere wat via die fascia netwerk aan mekaar en sodoende aan die posterior kompartement van die onderbeen gekoppel is, is deur middel van ‘n intensiewe literatuursoektog geïdentifiseer. Hierdie spiere is die *klinies belangrike spiere* genoem en ‘n styfheid in enige een van hierdie spiere is teoreties dus in staat om kragte in die miofasiale ketting te induseer wat dan weer die kragte op die posterior kompartement oordra. Die loslating van styfheid in hierdie spiere ekstern tot die posterior kompartement deur middel van sagteweefsel mobilisatietegnieke, voorsien ‘n effektiewe konserwatiewe benadering tot die behandeling van die simptome van KPKS. ‘n Hersiene model wat die patologie van KPKS visueel voorstel is ontwikkel en dien as basis vir die konserwatiewe behandeling van die simptome van KPKS. Hierdie model is bevestig deur gebruik te maak van ‘n gemengde metodologiese benadering wat ‘n reeks van ondersoekende sowel as verduidelikende gevallestudies ingesluit het. Die



kwalitatiewe benadering was aangevul met kwantitatiewe eksperimente waartydens oorsaaklike verwantskappe met biomeganiese faktore ondersoek was. Die behandelingsbenadering was 'n honderd persent suksesvol en die resultate van die eksperimentele navorsing wat uitgevoer was, ondersteun dus die nuwe teoretiese model vir die patogenese van KPKS.

Sleutelwoorde:

Kroniese posterior kompartementsindroom; Patogenese; Fasia; Sagteweefsel mobilisasies; Miofasiale ketting; Sagteweefsel mobilisasetegnieke; Konserwatiewe behandeling; Kollageen weefsel; Hardloopbeserings; Kwalitatiewe navorsings paradigmas; Gemengde metodologie; Alternatiewe tot chirurgiese behandeling



TABLE OF CONTENTS

ACKNOWLEDGEMENTS	ii
ABSTRACT	iii
OPSOMMING	v
TABLE OF CONTENTS	vii
LIST OF FIGURES	xvi
LIST OF TABLES	xviii
LIST OF ABBREVIATIONS	xxv
GLOSSARY OF TERMS	xxvi

CHAPTER 1: THE SCOPE OF THE RESEARCH

1.1. INTRODUCTION AND BACKGROUND	1
1.2. THE RESEARCH PROBLEM	2
1.3. THE RESEARCH QUESTION	4
1.4. INVESTIGATIVE QUESTIONS	5
1.5. KEY RESEARCH OBJECTIVES	6
1.6. SIGNIFICANCE OF THE RESEARCH	6
1.7. THE RESEARCH PROCESS	7
1.7.1. Phase 1 – Exploratory research	7
1.7.2. Phase 2 – Explanatory research	9
1.8. THE RESEARCH DESIGN AND METHODOLOGY	11
1.9. RESEARCH ASSUMPTIONS	12
1.10. RESEARCH CONSTRAINTS	13
1.11. CONTEXTUAL BOUNDARIES	13
1.11.1. Limitations	13
1.11.2. Delimitations	14
1.12. CONCLUSION	14

CHAPTER 2: LITERATURE REVIEW

2.1. INTRODUCTION	16
2.2. RESEARCH METHODOLOGY	16
2.2.1. An introduction to qualitative research	16



2.2.2.	Mixed methodologies	18
2.2.3.	Case study research methodology	19
2.2.3.1.	General approach to case study design	20
2.2.3.2.	Components of research design	21
2.2.3.3.	The role of theory in design	24
2.2.3.4.	Criteria for judging the quality of research designs	24
2.2.3.5.	Case study designs	27
2.2.3.6.	Dimension and classification of case studies	32
2.2.3.7.	Protocol	33
2.2.3.8.	Synthesis and knowledge integration in imbedded case study research	36
2.2.3.9.	Case study protocol as design	41
2.2.4.	Experimental study designs	45
2.2.5.	Conclusion	47
2.3.	CHRONIC POSTERIOR COMPARTMENT SYNDROME	47
2.3.1.	Introduction	47
2.3.2.	Chronic compartment syndrome	48
2.3.2.1.	Anatomy of compartments and their muscles	48
2.3.2.2.	Definition of chronic posterior compartment syndrome (CPCS)	49
2.3.2.3.	Pathogenesis of chronic posterior syndrome (CPCS)	52
2.3.2.4.	Prevalence of compartment syndrome	54
2.3.2.5.	Symptoms of chronic posterior compartment syndrome	55
2.3.2.6.	The differentiation of CPCS from other symptom related conditions	56
2.3.2.7.	Intra-compartmental pressure measurement as confirmation of the diagnosis of CPCS	61
2.3.2.8.	Surgical management of chronic compartment syndrome	63
2.3.2.9.	Conservative management of chronic compartment syndrome	69
2.3.3.	Functional anatomy and biomechanical factors	73
2.3.3.1.	Muscles of the posterior compartments of the lower leg	74
2.3.3.2.	Muscles of the anterior compartments of the lower leg	77
2.3.3.3.	Muscles of the lateral compartments of the lower leg	78



2.3.3.4. Normal running gait	79
2.3.3.5. Dorsi flexion at the ankle joint	84
2.4. KNOWLEDGE OF FASCIA	85
2.4.1. Composition of normal fascia	85
2.4.2. Manual therapy techniques for connective tissue dysfunction	88
2.4.3. Reflection	90
2.5. THE CONTINUITY OF THE SOFT TISSUE LINKS	92
2.5.1. Introduction	92
2.5.2. Description of the myofascial links	93
2.5.3. Posterior myofascial links of the trunk	94
2.5.4. Anterior myofascial links of the trunk	97
2.5.5. Fascia of the leg	100
2.5.6. Conclusion	101
 CHAPTER 3: METHODOLOGY	
3.1. INTRODUCTION	103
3.2. EXPLORATORY RESEARCH DESIGN	103
3.2.1. The basis for exploratory research design	104
3.2.2. Design Classification	105
3.2.3. Unit of Analysis	106
3.2.4. Subjects	106
3.2.4.1. Inclusion criteria	106
3.2.4.2. Exclusion criteria	106
3.2.4.3. Recruitment of subjects	107
3.2.4.4. Randomness	108
3.2.5. Database	108
3.2.6. Ethical considerations	108
3.2.7. The research question	109
3.2.8. Investigative questions	109
3.2.9. Theoretical framework	110
3.2.10. Propositions	111
3.2.11. Rival theories	111
3.2.12. Data collection	111



3.2.13. Schedule and reviews	112
3.2.14. Criteria for interpreting results	112
3.2.15. Variables and associated measures	112
3.2.16. Research Process	113
3.2.16.1. Subjective assessment – Interview	113
3.2.16.2. Objective Assessment – Physical examination	114
3.2.17. Intervention	116
3.2.18. Data recording	119
3.2.19. Quality assurance measures	120
3.2.20. Modification of the exploratory research design	121
3.2.21. Conclusion	122
3.3. THE EXPLANATORY RESEARCH DESIGN	122
3.3.1. The research question	123
3.3.2. Theoretical framework	123
3.3.3. Propositions	123
3.3.4. Rival theories	124
3.3.5. The Research Process	125
3.3.6. Conclusion	125
3.4. EXPERIMENTAL RESEARCH	126
3.4.1. Introduction	126
3.4.2. Degree of extension at the metatarsophalangeal joint during terminal stance	126
3.4.2.1. Aim of the study	126
3.4.2.2. Hypothesis	126
3.4.2.3. Research design	127
3.4.2.4. Sample selection	127
3.4.2.5. Inclusion and exclusion criteria for the controls	127
3.4.2.6. Inclusion and exclusion criteria for the subjects	128
3.4.2.7. Outcome measures	128
3.4.2.8. Procedure	128
3.4.3. The effect of soft tissue mobilization on subtalar over pronation in sportsmen	129
3.4.3.1. Introduction	129



3.4.3.2. Aim of the study	129
3.4.3.3. Hypothesis	130
3.4.3.4. Experimental design	131
3.4.3.5. Subjects	131
3.4.3.6. Procedure	132
3.4.3.7. Data management and analysis	133

CHAPTER 4: RESEARCH RESULTS

4.1. INTRODUCTION	135
4.2. EXPLORATORY RESEARCH PHASE	135
4.2.1. Introduction to the exploratory research	135
4.2.2. CASE STUDY 1	135
4.2.2.1. Introduction	135
4.2.2.2. Subject	136
4.2.2.3. The research question	136
4.2.2.4. Theoretical framework	137
4.2.2.5. Propositions	138
4.2.2.6. Rival theories	138
4.2.2.7. Schedule and reviews	138
4.2.2.8. Criteria for interpreting results	138
4.2.2.9. The research procedure	139
4.2.2.10. Interventions and data recording	143
4.2.2.11. Conclusion	154
4.2.2.12. Knowledge integration	154
4.2.3. CASE STUDY 2	156
4.2.3.1. Introduction	156
4.2.3.2. Subject	156
4.2.3.3. The research question	156
4.2.3.4. Theoretical framework	157
4.2.3.5. Propositions	157
4.2.3.6. Rival theories	157
4.2.3.7. Criteria for interpreting results	157
4.2.3.8. The Research Procedure	157



4.2.3.9. Intervention and data recording	163
4.2.4. CASE STUDY 3	167
4.2.4.1. Introduction	167
4.2.4.2. Subject	168
4.2.4.3. The research question	168
4.2.4.4. Theoretical framework	168
4.2.4.5. Propositions	169
4.2.4.6. Rival theories	169
4.2.4.7. The Research Procedure	170
4.2.4.8. Interventions and data recording	174
4.2.4.9. Integration	178
4.2.5. Conclusion	180
4.3. THE DEVELOPMENT OF THE CONCEPT OF CLINICALLY SIGNIFICANT MUSCLES	181
4.3.1. Introduction	181
4.2.2. Myofascial links and clinically significant muscles	182
4.2.3. Significance of the myofascial links	182
4.2.4. Conclusion	185
4.4. THE REVISED THEORETICAL FRAMEWORK	186
4.4.1. Introduction	186
4.4.2. The current theoretical model	186
4.4.3. The theoretical gap	188
4.4.4. A revised model for the pathogenesis of CPCS	189
4.4.5. Rationale for the treatment approach	193
4.4.6. Conclusion	193
4.5. EXPLANATORY RESEARCH RESULTS	194
4.5.1 INTRODUCTION	194
4.5.2 CASE STUDY 4	196
4.5.2.1 The subject	196
4.5.2.2 Research Procedure	196
4.5.2.3 Interventions	205
4.5.2.4 Synthesis/discussion	212



4.5.3	CASE STUDY 5	213
4.5.3.1	The subject	213
4.5.3.2	Research Procedure	213
4.5.3.3	Interventions	220
4.5.3.4	Synthesis/discussion	225
4.5.3.5	Quality assurance measures	226
4.5.4	CASE STUDY 6	226
4.5.4.1	The subject	226
4.5.4.2	Research Procedure	227
4.5.4.3	Interventions	234
4.5.4.4	Synthesis/discussion	239
4.6	CROSS CASE STUDY COMPARISON	241
4.6.1.	Introduction	241
4.6.2.	The symptoms prior and post intervention	244
4.6.3.	Tightness in clinically significant muscles	245
4.6.3.1.	Relative tightness on the left	246
4.6.3.2.	Relative tightness on the right	245
4.6.3.3.	Summary	253
4.6.4.	Assessment of other abnormalities	253
4.6.4.1.	Muscle imbalances	253
4.6.4.2.	Running movement pattern abnormalities	260
4.6.5.	Conclusion	275
4.7.	EXPERIMENTAL RESEARCH	277
4.7.1.	Introduction	277
4.7.2.	Degree of extension at the metatarsophalangeal joint during terminal stance	277
4.7.2.1.	Results	277
4.7.2.2.	Discussion	277
4.7.3.	The effect soft tissue mobilization on subtalar over pronation	282
4.7.3.1.	Results	282
4.7.3.2.	Discussion	283
4.7.4.	Conclusion	284



4.8.	RESEARCH VALIDATION	284
4.8.1	CASE STUDY 7	284
4.8.1.1	The subject	284
4.8.1.2	Research Procedure	285
4.8.1.3	Interventions	294
4.8.1.4	Synthesis/discussion	299
4.8.2	CASE STUDY 8	299
4.8.2.1	The subject	299
4.8.2.2	Research Procedure	300
4.8.2.3	Interventions	305
4.8.2.4	Synthesis/discussion	311
4.8.3	Reflection	311
4.8.3.1	Knowledge from the literature study	312
4.8.3.2	Knowledge gained from experimentation	313
4.8.4	Validation of tightness assessment technique	314

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1	INTRODUCTION	318
5.2	KNOWLEDGE INTEGRATION	319
5.2.1.	Replication of results	319
5.2.2.	Muscle tightness	320
5.2.3.	Muscle imbalances	320
5.2.4.	Gait analysis	321
5.2.5.	Biomechanical measures	321
5.3.	THE RESEARCH PROBLEM	322
5.4.	THE RESEARCH AND INVESTIGATIVE QUESTIONS	323
5.5.	KEY RESEARCH OBJECTIVES	325
5.6.	SIGNIFICANCE OF THE RESEARCH	326
5.7.	THE RESEARCH PROCESS	326
5.8.	THE RESEARCH DESIGN AND METHODOLOGY	328
5.9.	CONTEXTUAL BOUNDARIES AND SHORTCOMINGS	328
5.10.	RECOMMENDATIONS	330
	REFERENCES	331



APPENDICES	344
APPENDIX 1: STUDENT PROTOCOL AND THE ETHICAL COMMITTEE	345
APPENDIX 2: PATIENT INFORMED CONSENT	346
APPENDIX 3: E-MAIL FOR THE RECRUITMENT OF SUBJECTS	351



LIST OF FIGURES

Figure 1.1	The research process – Phase 1	8
Figure 1.2	The research process – Phase 2	10
Figure 2.1	Theory of knowledge	36
Figure 2.2	Brunswikian Lens Model	40
Figure 2.3	Proposed pathogenesis of CPCS	54
Figure 2.4	Rotation of the Achilles tendon	77
Figure 2.5	The thoraco-dorsal fascia and its links	95
Figure 2.6	The gluteus maximus muscle and its fascia links	96
Figure 2.7	The continuity of the myofascial links through the sacroiliac ligament	96
Figure 2.8	The myofascial links connecting to the sacrotuberous ligament	97
Figure 2.9	An illustration of some of the anterior myofascial links	97
Figure 2.10	Examples of anterior and posterior trunk fascia links to one another	99
Figure 3.1	Pathogenesis of CPCS	110
Figure 3.2	Anatomy of the compartments of the lower leg	116
Figure 3.3	Mobilization of the posterior inter-muscular septum	117
Figure 3.4	Soft tissue mobilization of the deep transverse fascia	117
Figure 3.5	Mobilization of the fascia between the soleus- and gastrocnemius muscles	118
Figure 3.6	Modification of exploratory designs	121
Figure 3.7	Proposed modified model for the pathogenesis of CPCS	124
Figure 3.8	Fascial stress induced pronation	130
Figure 3.9	Measurement by means of Coral Draw software	132
Figure 4.1	Pathogenesis of CPCS	137
Figure 4.2	The chronological development of Case Study 1	154



Figure 4.3	Modified theoretical framework (Case Study 1)	155
Figure 4.4	The evolved theoretical framework	169
Figure 4.5	A summary of the different posterior myofascial links	183
Figure 4.6	A summary of the different anterior myofascial links	184
Figure 4.7	Posterior compartments	188
Figure 4.8	Induced stresses in posterior compartments	191
Figure 4.9	Modified model for the pathogenesis of CPCS	192
Figure 4.10	Progressive change from <i>Exploration</i> to <i>Explanation</i>	242
Figure 4.11	Correlations between peak torque performance pre- and post intervention	258
Figure 4.12	Correlation between work performed per repetition pre- and post intervention	260
Figure 4.13	Metatarsophalangeal extension	278
Figure 4.14	Improvement of the metatarsophalangeal extension: left leg	280
Figure 4.15	Improvement of the metatarsophalangeal extension: right leg	281
Figure 4.16	Normalisation of hind foot pronation	283
Figure 5.1	Towards a new conception of the pathogenesis of CPCS	318



LIST OF TABLES

Table 2.1	Tactics for ensuring quality research designs	24
Table 2.2	Different kinds of rival explanations	26
Table 2.3	Basic types of designs for case studies	30
Table 2.4	Dimensions and classifications of case studies	32
Table 2.5	Case study protocol conformance matrix	43
Table 2.6	Summary of the anatomy of the compartments of the lower leg	50
Table 2.7	Summary of the occurrence of chronic compartment syndrome	55
Table 2.8(a)	Outcomes of surgical interventions during 1983 to 1998	67
Table 2.8(b)	Outcomes of surgical interventions during 1998 to 2002	68
Table 2.9	Sequence of movement at the pelvis, hips, knees, ankles and feet during running	80
Table 3.1	Design classification of Case Study 1	105
Table 3.2	Case study questions	109
Table 3.3	Case study variables and associated measures	113
Table 3.4	Quality assurance measures	120
Table 3.5	Dimensions and classifications of the experiment	127
Table 4.1	Outcomes of running gait analysis for Case Study 1 prior to intervention	142
Table 4.2	Muscle strength results prior to intervention: Case Study 2	158
Table 4.3	Outcomes of running gait analysis for Case Study 2 prior to intervention	161
Table 4.4	Biomechanical angles: Case Study 2 during intervention	162
Table 4.5	Muscle strength results prior to intervention: Case Study 3	171
Table 4.6	Outcomes of the running gait analysis for Case Study 3 prior to intervention	172
Table 4.7	Biomechanical angles for Case Study 3 during intervention	173
Table 4.8	The intensity of pain/ discomfort before and after intervention	179
Table 4.9	The distance run before commencement of symptoms	179
Table 4.10	The total weekly-distances run before and after intervention.	179



Table 4.11	Muscle imbalances in peak torque performance prior to interventions	180
Table 4.12	A summary of the chronological progression of case studies 1 to 3	181
Table 4.13	Clinically significant muscles	185
Table 4.14	Isokinetic dynamometer test results* prior to intervention: Case Study 4	200
Table 4.15 (a)	Running gait analysis: Case Study 4 prior to intervention (Upper body)	201
Table 4.15 (b)	Running gait analysis: Case Study 4 prior to intervention (Lower body)	202
Table 4.16	Biomechanical angles: Case Study 4	203
Table 4.17	Tightness of clinically significant muscles: Case Study 4 prior to intervention:	204
Table 4.18	Isokinetic dynamometer test results after intervention: Case Study 4	208
Table 4.19	Running gait analysis: Case Study 4 after intervention	209
Table 4.20	Biomechanical angles: Case Study 4	210
Table 4.21	Tightness of clinically significant muscles: Case Study 4 after intervention	211
Table 4.22	Isokinetic dynamometer test results* prior to intervention: Case Study 5	215
Table 4.23(a)	Running gait analysis: Case Study 5 prior to intervention (Upper body)	216
Table 4.23(b)	Running gait analysis: Case Study 5 prior to intervention (Lower body)	217
Table 4.24	Biomechanical angles: Case Study 5 during intervention	218
Table 4.25	Tightness of clinically significant muscles: Case Study 5 prior to intervention	219
Table 4.26	Running gait analysis: Case Study 5 after intervention	222
Table 4.27	Biomechanical angles: Case Study 5	223
Table 4.28	Tightness of clinically significant muscles: Case Study 5 (Final)	224



Table 4.29	Isokinetic dynamometer test results prior to intervention: Case Study 6	229
Table 4.30 (a)	Running gait analysis: Case Study 6 prior to intervention (Upper body)	230
Table 4.30 (b)	Running gait analysis: Case Study 6 prior to intervention (Lower body)	231
Table 4.31	Biomechanical angles: Case Study 6 prior to intervention	232
Table 4.32	Tightness of clinically significant muscles: Case Study 6 prior to intervention	233
Table 4.33	Running gait analysis: Case Study 6 after intervention	236
Table 4.34	Biomechanical angles: Case Study 6 after intervention	237
Table 4.35	Tightness of clinically significant muscles: Case Study 6 after intervention (Date: 25/10/2003) (Interim)	238
Table 4.36	Tightness of clinically significant muscles: Case Study 6 (Final) (Date: 24/01/2004)	240
Table 4.37	A summary of the chronological progression of case studies 1 to 6	243
Table 4.38	Intensity of pain and discomfort before and after intervention	244
Table 4.39	Commencement of symptoms before and after intervention	244
Table 4.40	The total weekly-distances run before and after intervention	245
Table 4.41 (a)	Relative tightness of posterior links prior to intervention (left)	246
Table 4.41 (b)	Relative tightness of anterior links prior to intervention (left)	247
Table 4.42 (a)	Relative tightness of posterior links post intervention (left)	248
Table 4.42 (b)	Relative tightness of the anterior links post intervention (left)	249
Table 4.43 (a)	Relative tightness of posterior links prior to intervention (right)	250
Table 4.43 (b)	Relative tightness of anterior links prior to intervention (right)	251
Table 4.44 (a)	Relative tightness of the posterior links post intervention (right)	252
Table 4.44 (b)	Relative tightness of the anterior links post intervention (right)	253



Table 4.45	Muscle imbalances in peak torque performance (Prior to treatment)	254
Table 4.46	Muscle imbalances: work performance per repetition (Prior to treatment)	255
Table 4.47	The effect of the treatments on peak torque performance (Nm)	257
Table 4.48	Analysis of the effect of treatment on work performance (Nm/sec)	259
Table 4.49(a)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Upper Body - Shoulder)	261
Table 4.49(b)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Upper Body - Thoracic region)	262
Table 4.49(c)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Upper Body – Pelvis)	262
Table 4.50(a)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Lower Body -Hip)	263
Table 4.50(b)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Lower Body -Knee)	263
Table 4.50(c)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Lower Body -Ankle)	264
Table 4.50(d)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – initial contact (Lower Body -Toes)	264
Table 4.51(a)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – loading response (Pelvis)	265
Table 4.51(b)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – loading response (Hip)	265
Table 4.51(c)	A comparative summary of running gait analysis prior and post intervention: weight acceptance phase – loading response (Ankle)	266



Table 4.52(a)	A comparative summary of running gait analysis prior and post intervention: Single leg support – mid stance phase (Pelvis)	266
Table 4.52(b)	A comparative summary of running gait analysis prior and post intervention: Single leg support – mid stance phase (Hip)	267
Table 4.52(c)	A comparative summary of running gait analysis prior and post intervention: Single leg support – mid stance phase (Ankle)	267
Table 4.53(a)	A comparative summary of running gait analysis prior and post intervention: Single leg support – terminal stance phase (Pelvis)	268
Table 4.53(b)	A comparative summary of running gait analysis prior and post intervention: Single leg support – terminal stance phase (Hip)	268
Table 4.53(c)	A comparative summary of running gait analysis prior and post intervention: Single leg support – terminal stance phase (Ankle)	269
Table 4.53(d)	A comparative summary of running gait analysis prior and post intervention: Single leg support – terminal stance phase (Toes)	269
Table 4.54(a)	A comparative summary of running gait analysis prior and post intervention: Single leg support – pre swing phase (Pelvis)	270
Table 4.54(b)	A comparative summary of running gait analysis prior and post intervention: Single leg support – pre swing phase (Hip)	270
Table 4.54(c)	A comparative summary of running gait analysis prior and post intervention: Single leg support – pre swing phase (Ankle)	271
Table 4.55(a)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – initial swing phase (Knee)	271
Table 4.55(b)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – initial swing phase (Ankle)	272
Table 4.56(a)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – mid swing phase (Hip)	272
Table 4.56(b)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – mid swing phase (Knee)	273



Table 4.57(a)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – terminal swing (Pelvis)	273
Table 4.57(b)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – terminal swing (Hip)	274
Table 4.57(c)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – terminal swing (Ankle)	274
Table 4.57(d)	A comparative summary of running gait analysis prior and post intervention: swing leg advancement – terminal swing (Toe)	275
Table 4.58	Metatarsophalangeal extension at the first toe	277
Table 4.59	Biomechanical measures before and after intervention	280
Table 4.60	Change in left hind foot pronation before and after intervention	282
Table 4.61	Change in right hind foot pronation before and after intervention	282
Table 4.62	Isokinetic dynamometer test results* prior to intervention: Case Study 7	287
Table 4.63(a)	Running gait analysis: Case Study 7 prior to intervention (Upper body)	288
Table 4.63(b)	Running gait analysis: Case Study 7 prior to intervention (Lower body)	289
Table 4.64	Biomechanical angles: Case Study 7 before intervention	292
Table 4.65	Tightness of clinically significant muscles: Case Study 7 prior to intervention	293
Table 4.66	Isokinetic dynamometer test results* after intervention: Case Study 7	295
Table 4.67	Running gait analysis: Case Study 7 after intervention	296
Table 4.68	Biomechanical angles: Case Study 7 after intervention	297
Table 4.69	Tightness of clinically significant muscles: Case Study 7 after intervention	298
Table 4.70	Isokinetic dynamometer test results* prior to intervention: Case Study 8	302
Table 4.71(a)	Running gait analysis: Case Study 8 prior to intervention (Upper body)	303



Table 4.71(b)	Running gait analysis: Case Study 8 prior to intervention (Lower body)	304
Table 4.72	Biomechanical angles: Case Study 8 before intervention	305
Table 4.73	Tightness of clinically significant muscles: Case Study 8 prior to intervention	306
Table 4.74	Running gait analysis: Case Study 8 after intervention	309
Table 4.75	Tightness of clinically significant muscles: Case Study 8 after intervention	310
Table 4.76	Summary of biomechanical angles: Case Study 8	311
Table 4.77	Validation of soft tissue rating process (Posterior fascia links)	315
Table 4.78	Validation of soft tissue rating process (Anterior fascia links)	316
Table 4.79	Analysis of validation data on tightness	317



LIST OF ABBREVIATIONS

AMA	American Medical Association
CACS	Chronic Anterior Compartment Syndrome
CCS	Chronic Compartment Syndrome
CECS	Chronic Exertional Compartment Syndrome
CPCS	Chronic Posterior Compartment Syndrome
CT	Connective Tissue
ECM	Extracellular Matrix
EDL	Extensor Digitorum Longus
ERLP	Exercise Related Leg Pain
FDL	Flexor Digitorum Longus
FHL	Flexor Hallucis Longus
Inv	Inversion
km	Kilometre
km/h	Kilometre per hour
mm	Millimetre
MTP	Metatarsophalangeal
Nm	Newton-metre
Nm/s	Newton-metre per second
TA	Tibialis Anterior
TDF	Thoraco-Dorsal Fascia
PB	Peroneus Brevis
PCS	Posterior Compartment Syndrome
PF	Plantar Flexion
PG	Protoglycans
PT	Peroneus tertius
VAS	Visual Analogue Scale
S.v.	Sub verbo



GLOSSARY OF TERMS

Chronic posterior compartment syndrome

Chronic posterior compartment syndrome is a pathological condition of skeletal muscle characterized by increased interstitial pressure within an anatomically confined muscle compartment, specifically the posterior compartment, which interferes with the circulation and function of the muscle and neurovascular components of the compartment (Nicholas & Herschman, 1995a).

Dysfunctional fascia

Fascia, in the normal healthy state is relaxed and wavy in configuration. Due to its visco-elastic biomechanical properties it has a limited ability to “stretch” and move without restriction. When connective tissue experiences physical trauma, scarring or inflammation, the fascia loses its pliability (Culav *et al.*, 1999). It becomes tight, restricted and a source of tension to the rest of the body (dysfunctional). Trauma, such as a repetitive strain injury, has cumulative effects. The changes they cause in the fascial system influence comfort and the functioning of the body.

Micro-structurally, the end results of the healing / reorganizing process in connective tissue are that the tissue a) has a more irregular arrangement (the arrangement and the alignment are a result of the mechanical stresses applied to the tissue); b) has a lower water content and c) contains more random cross-links between fibres, fibre bundles and adjacent tissues. As the collagen fibres are more randomly aligned with respect to forces applied to the tissue, the fibres must resist forces that are not parallel to their longitudinal axes. This is a task for which collagen is not structurally designed. In addition the loss of water diminishes the ease with which the collagen bundles might slide past one another (Threkeld, 1992). In other words, the fascia does not function the way it was designed to. Fascia that has been injured and has undergone structural changes affecting its function, as mentioned above, will therefore be called dysfunctional fascia by the researcher.



Effective functional length of myofascial chain

The researcher has defined the *effective functional length of myofascial chain* as that length of the myofascial web that is available for the execution of a normal range of body movements. Restrictions in the myofascial web could thus compromise the range of normal movement.

Muscle imbalances

Muscle imbalances can be described as a deviation from a theoretical optimal posture or movement by a disproportional effort from muscles working around a joint or joint series. In relation to gait, this can result in abnormal stress through the kinetic chain causing deformities, pathology and symptoms. (Harradine *et al.*, 2006)

Myofascia

The word “myofascial” connotes the bundled together, inseparable nature of muscle tissue (myo-) and its accompanying web of connective tissue (fascia) (Comerford, 2000; Myers, 2001).

Myofascial chain

The word “chain” indicates the continuous nature of the myofascia throughout the body (Robertson, 2001).

Myofascial links

The word “links” implies that the muscles are linked via the fascia to one another (Myers, 2003).

Myofascial release techniques according to Manheim (1994) and Barnes (1990)

Myofascial procedures vary significantly, ranging from prolonged stretching and soft tissue mobilizing techniques to subtle indirect techniques (Manheim, 1994). Barnes (1990) has defined myofascial release techniques as the three-dimensional application of sustained pressure and movement into the fascial system in order to eliminate fascial restrictions.



Pronation

Pronation is classically defined as abduction and eversion of the foot along with hind foot eversion (Dugan & Bhat, 2005).

Release

Release means to set free from restraint (Concise English Dictionary, 1982, S.v. 'release'); to allow moving or flowing freely (The Concise Oxford English Dictionary, 2002, S.v. 'release').

Restrictions in the myofascial chain

Restrictions in the myofascial chain have been defined by the researcher as anything that can lead to a decrease in the *effective functional length of the myofascial chain*, such as trigger points, scar tissue and inflammation.

Runner

A person who runs a minimum distance of between 20 to 30 km per week on a regular basis and has been running consistently for a minimum period of time exceeding one year (Hreljac, 2005).

Soft tissue mobilization techniques

For the purpose of this specific research, soft tissue mobilizing techniques will refer to a variety of soft tissue mobilizing techniques aimed at the release of the tightness of tight myofascial tissue. The following soft tissue approaches were used:

- trigger point release techniques according to Travell and Simons (1999);
- myofascial release techniques according to Barnes (1990) and Manheim (1994);
and
- specific soft tissue mobilizations according to Hunter (1998).

Specific soft tissue mobilizing techniques

This approach relies on the use of specific soft tissue mobilization techniques which are applied to a specific area of tightness with the aim of restoring normal movement (Hunter, 1998).



Trigger point release techniques

Active trigger points are deactivated through ischemic compression. Ischemic compression applies sustained pressure to the trigger point with sufficient force and for a long enough time to deactivate it (Travell & Simons, 1999).