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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My parents, for creating and encouraging my love for continuous education.
ABSTRACT

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| DEPARTMENT | Biokinetics, Sports and Leisure Sciences  
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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

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Kroniese posterior kompartementsindroom (KPKS) van die onderbeen is ‘n patologiese toestand wat ervaar word deur persone wat aan oefeningsverwante aktiwiteitie 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 fasia 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 ontwikkels. Daar is bevind dat die huidige teoretiese grondslag vir die behandeling van die toestand nie die kontinuiteit en die onelastisiteit van die fasia netwerk, wat ‘n groot rol in die sindroom speel, in ag neem nie. Spiere wat via die fasia netwerk aan mekaar en sodoende aan die posterior kompartement van die onderbeen gekoppels 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 teories dus in staat om kragte in die miofasiale ketting te inducer 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 mobilisasiestegnieke, voorsien ‘n effektiewe konserwatiewe benadering tot die behandeling van die simptome van KPKS. ‘n Hersiene model wat die patologie van KPKS visueel voorstel is ontwikkels 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 biomekaniese 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 mobilisasietechnieke; Konservatiewe behandeling; Kollageen weefsel; Hardloopbesserings; Kwalitatiewe navorsings paradigmas; Gemengde metodologie; Alternatiewe tot chirurgiese behandeling*
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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**


**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);
- 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).