Pre-Clinical Research

The MSK-FP Method

An Empirical Evidence-Based Approach to Osteopathy

A RESEARCH DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF OSTEOPATHY
ON THE NINETEENTH OF MARCH IN THE YEAR TWENTY-TWENTY FOUR

IN BRIEF

The Musculoskeletal Functional Performance Method, colloquially referred to as the MSK-FP, is a system of assessment and management of musculoskeletal complaints and disorders developed by the Canadian Osteopath Antonio Marcello Colasurdo.

This method equips therapists with a framework whereby qualitative and quantitative tests may help to objectively qualify and quantify a clinical presentation, as well as quantify clinical progress achieved, over the course of the entire intervention process.

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Word Count: 11,963

Colasurdo A, (2024). The MSK-FP Method. An Empirical Evidence-Based Approach to Osteopathy. NUMSS DO Research Dissertation.

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CHAPTER 1 OSTEOPATHIC HISTORY, THEORY, AND PRACTICE

1.1 THE FRACTURING OF EARLY OSTEOPATHY

The practice of Osteopathy originated within the United States of America; having been founded by an American physician whose named Dr. Andrew Taylor Still. At this time, the profession was unified, and all Osteopaths were recognized as complete medical physicians with specialized expertise in Osteopathic Manual Therapy.

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However, when a pupil of Dr. Still's known as John Martin Littlejohn, attempted to expand the profession to London, England; sanctions were place upon the profession whereby graduates were restricted to solely practice Manual Osteopathy, also known as Osteopathic Therapy, which negated their rights to medical practice.

This demarcating moment in history caused the profession of Osteopathy to fragment into two professional streams; whereby graduates of American Osteopathy remained eligible to practice medicine in its entire scope; graduates of European Osteopathy, also referred to as Manual Osteopathy, became restricted to the practices of Osteopathic Therapy.

This separation, which occurred in the year 1917, during the profession's attempt to expand internationally, can be perceived as ***the* singular greatest failure of early Osteopathy**.

For the reason that, as practitioners of American Osteopathy sought further recognition; practitioners of European Osteopathy stagnated and failed to derive professional evidence-based clinical guidelines and strategies concerning the practices of its profession. [94] Furthermore, throughout the second half of the

THIS RESEARCH THESIS IS SUBMITTED TO THE NATIONAL UNIVERSITY OF MEDICAL SCIENCES, SPAIN FOR THE DEGREE OF *DOCTOR OF OSTEOPATHY*

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CITATION
Colasurdo A, (2024). The MSK-FP Method.
An Empirical Evidence-Based Approach to Osteopathy.
NUMSS DO Research Dissertation.

TOPIC ACCEPTED BY NUMSS
November 20, 2022

SUBMISSION DEADLINE
May 31, 2024

nineteenth century; as the popularity of evidence-based medicine and evidence-based practice grew, thanks to the efforts of prominent figures such as Dr. David Sackett and Dr. Gordon Guyatt [94]; European Osteopathy languished further by allowing pseudoscientific systems to worm their way into the practices of its profession and claim affiliation.

In consequence, Osteopathy has become entangled with Complementary and Alternative systems of care, which sequentially caused division amongst scientists, concerning the plausibility of various practices within the Osteopathic Therapy field.

For instance, certain practices such as Musculoskeletal Osteopathy shows a moderate-quality of evidence concerning its clinical applications [98], while in contrast, other practices such as Cranial and/or Visceral Osteopathy are continuously called into question, regarding their reliability and efficacy. [99] [100] [101]

Because of this inner-profession conflict between evidence-based and non-evidence supported practices; the entire scope of European Osteopathy is continuously brought under scrutiny by scientific and evidence-based communities, with regards to the profession's validity and employability within a medical and/or allied health care context.

1.2 CONSIDERING OSTEOPATHY AN ALLIED HEALTH PRACTICE

One of the main points of contention concerns itself with the integration of European Osteopathy into the medical system as an Allied Health Practice.

Allied Health Professions Australia, the national voice for allied health professionals across that nation, defines allied health practitioners as "qualified [individuals] with specialized expertise in preventing, diagnosing, and treating a range of conditions and illnesses [while] often [working] within [the context of a] multidisciplinary health team to provide specialized support for different patient needs." [96]

Considering this, Osteopaths, hereby referred to as Osteopathic Therapists, are known to possess the inherent qualities and capabilities of intervening in cases whereby the function of the musculoskeletal system has become compromised.

Where osteopathic care may fall short of scientific and evidence-based standards however, is directly correlated to a therapist's use of unsupported and/or pseudoscientific modalities of care.

1.2.1 DEFINING OSTEOPATHIC PRACTICE

Furthermore, if indeed the profession Osteopathy possesses the clinical capacity to intervene in musculoskeletal cases; what therefore, should the professional scope of practice entail?

When examining the World Health Organization's release, the *Benchmark for Training in Osteopathy*; they define osteopathic practice as using "manual contact for diagnosis and treatment; [all the while respecting] the relationship of body, mind, and spirit in health and disease; [**emphasizing**] **the structural and functional integrity of the body** [as well as] the body's intrinsic tendency for self-healing." [2]

In addition, the American Association of Osteopathic Manual Practitioners was found to define the profession as a hands-on health practice that examines how the "skeleton, joints, muscles, nerves, circulation, connective [tissues], and internal organs [all] **function** [together] as a holistic unit." [1]

By keeping the rationales from these two prominent professional health organizations in mind, the profession of Osteopathy can be defined as having

the capacity to offer "patient-centred whole body approaches to health care **for functional improvement and pain relief**." [1]

1.2.2 STRUCTURE-FUNCTION INTERRELATION

This definition correlates well with Dr. Still's original philosophical core tenet:

THE STRUCTURES AND FUNCTIONING
OF THE BODY IS INTERRELATED

As understood by modern science, should a dysfunction arise from the overall structures and/or in the posture of the body, the ability to function optimally may begin to decline or may become limited. [3]

Inversely, should movement variability decrease, over time, this may instruct the body that certain movement patterns and/or muscular activations are no longer necessary. In turn, this may subsequently cause a cascade of effects whereby weaknesses in specific movement patterns become apparent, movement patterns become area(s) of instability, and/or movements become inaccessible. [4]

Therefore, Osteopaths should consider both, the structural components of the body, as well as the overall functioning of the body, prior to the development and rendering of a clinical impression.

1.3 OSTEOPATHIC THEORY OVERVIEW

This interrelationship of structure and function can be examined through three major perspectives:

1.3.1 THE BIOMECHANICS PERSPECTIVE

Biomechanics, which is "the study of forces acting on and generated within the body; [this study also examines] the effects of [said] forces on tissues, fluids, and/or materials used." [104] From this perspective "somatic components relate as a mechanism for posture and balance." [2]

Stresses or imbalances imposed upon this mechanism act as affectors and may trigger injury, which may subsequently impact dynamic function, increase energy expenditure, alter proprioception, change joint structure, impede neurovascular function, and/or may alter metabolism. [2]

These injuries are typically expressed as either:

An **Acute Trauma Load-Tolerance Injury**, which can arise from a singular identifiable event; this can include: *fractures*, *lacerations*, and/or *contusions*. [104] Disorders which arise from an acute trauma "occur when transient external loads, which are transmitted through biomechanical loading, [exceeds] internal tolerances of affected tissues [causing] mechanical strain"; [104] this may result in pain, discomfort, impairment, and/or disability.

On the other hand, a **Cumulative Trauma Load-Tolerance Injury** may arise from a "complex interaction of events that accumulate over time [as] transient external loads, in isolation, [may] be insufficient to exceed internal tolerances of tissues." [104] In this scenario, when loading accumulates over time, either through repeated exposures, or through exposures of a sufficient duration, the internal tolerances of tissues eventually exceeds their limits, thereby resulting in injury. [104]

1.3.2 THE NEUROLOGICAL PERSPECTIVE

In addition, Neurology can be defined as the study and treatment of nervous system disorders.

In this senario, when considering neurogenic components; therapists should mainly concern themselves with the neural circuitry relationship, which influences biomechanics; as the "influence of spinal [facilitations], proprioceptive function, the autonomic nervous system, and [the activities] of

nociceptors on the function of the neuroendocrine immune network" [2] can impose additional stresses or imbalances on biomechanic function, either through an imbalanced conduction of neuronal information, and/or through an increase in nociceptive activity. [2]

1.3.3 THE BIOENERGETICS PERSPECTIVE

Moreover, Bioenergetics is the biochemical study of energy relationships, and the study of energy transformations and transductions in living organisms. This branch of biochemistry and cellular biology is used to explain the body's innate ability to "maintain [a] balance between energy production, distribution, and expenditure." [2]

In maintaining said balance, the body remains capable of adapting to various biomechanical stressors and/or stimuli. [2]

1.3.4 HUMAN KINETICS

Being cognizant of the complex relationship between Biomechanics, Neural Circuitry, and Bioenergetics; therapists are enabled to evaluate Human Kinetics, which the Oxford Dictionary of Sports Science & Medicine defines as the "study of the art and science of human movement." [5]

The clinical application of human kinetics however, springs forth a novel inquiry:

If indeed, a lack of movement variability can create instabilities in the human body, as alluded to in *Section 1.2.2*; providing credence to Dr. Still's philosophical core tenet concerning the interrelationship of structure and function; how therefore can therapists objectively conclude that a dysfunction is structural in origin rather than functional?

In layman's terms, is it possible for a therapist to objectively differentiate between a structural and a functional concern; and subsequently, can said therapist successfully treat the musculoskeletal clinical presentation(s) without first requiring a medical diagnosis and/or medical imaging?

1.4 IS IT STRUCTURAL OR FUNCTIONAL?

In an effort to respond to this very question, as well as in an effort to apply a proper level of nuance to this very topic; many science-based models of operation were surveyed which includes Physical Therapy, Athletic Therapy, Orthopaedic, and Sports Medicine models of care, to name a few.

1.4.1 LIMITS OF THE TRADITIONAL MODEL

When contrasted, the traditional model of osteopathic care was found to be limited by the infiltration of pseudoscientific methods and theories, as well as by assessment processes leaning towards a qualitative nature, and neglecting the possible application(s) of quantitative methodologies.

This can include a neglect towards tools, such as outcome measures, an inclinometer, and/or a dynamometer; and/or a neglect in testing methods, including active functional performance testing. In consequence, therapists lose the opportunity to collect valuable information that may aid in the establishment of objective baselines, which can subsequently inform a clinical impression, progress of care, and/or a chosen intervention strategy.

As a cascading effect, this may cause an incomplete clinical impression to be drawn, and/or an incomplete intervention process to be put into effect.

Furthermore, traditional osteopathic treatment processes attempt to modulate pain and optimize biomechanic function primarily through the use of various manual therapy techniques, including: Osteoarticular Joint Mobilizations (MOBs), Muscle Energy Techniques (METs), Proprioceptive Neuromuscular Facilitation techniques (PNFs), Soft

Tissue techniques, Neurodynamics, amongst a number of other adjuncts.

In neglecting non-manual therapy methods however, such as Exercise Therapy (ET), which involves the prescription of movement to "correct impairments, restore muscular and skeletal function, and/or [to] maintain [an individual's overall] state of well-being [12]; professionals hinder themselves during care; and may subsequently be negatively impacting the profession from possibly becoming fully recognized by scientific and/or evidence-based communities.

1.4.2 THE PUBLIC VIEW OF OSTEOPATHY

In fact, these limitations have translated to the World Health Organization's view of the osteopathic profession, as they define the profession as *requiring manual contact to drive diagnosis and treatment*. [2]

Because of this, the public, and the W.H.O., have caused Osteopathy to become synonymous with the practices of Osteopathic Manual Therapy.

The goal(s) behind this research was to aid in the deriving of an evidence-based model of care, which can be easily adopted by Osteopaths into clinical practice; subsequently causing therapists to tailor their care towards the modulation of musculoskeletal pain, and towards the improvement of biomechanic function, as much as possible; through the use of evidence-based clinical guidelines and strategies.

CHAPTER 2 THE MSK-FP METHOD

2.1 INTRODUCTION AND BACKGROUND

In an effort to guide Osteopathic Therapists towards this evidence-based method of practice, while also simultaneously respecting the profession's scope of practice, so as not to infringe upon the operations of other professions within the Physical Medicine realm; the Musculoskeletal Functional Performance Method of Assessment and Intervention, colloquially referred to as The MSK-FP Method, was designed.

This model of care allows therapists to consider both, the structural components of the body and how they may be affected; as well as consider how the body is currently capable of performing functionally.

In doing so, therapists gain the ability to assess and analyze chief musculoskeletal complaints objectively, which subsequently allows them to craft traceable intervention strategies with individuals, and verify that minimal detectable changes (MDCs) are occurring in the clinical presentation(s).

The MSK-FP Method itself is broken down into four main stages of operation; as referenced in *Figure I*.

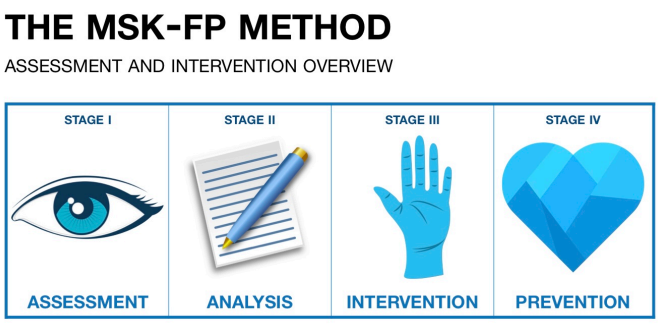


Figure I
The MSK-FP Method
Assessment and Intervention Overview
as Proposed by Antonio Marcello Colasurdo

The **Assessment Stage** involves collecting a detailed physical health history, which simultaneously includes the collection of a detailed symptomatology alongside patterns of pain referral; as well as the entire physical assessment and testing process itself; refer to *Chapter 4* for details.

Following the assessment process, therapists enter into the **Analysis Stage**; this involves the dissemination of all collected information, in an effort to understand the unique nature of the physical presentation(s) regarding pain phenotype, the anatomical structures affected and their pathology, as

well as any current limitation(s) found regarding functional capabilities; refer to *Chapter 5* for details.

Once issue(s) have been assessed and analyzed, it becomes the role of the therapist, to create and suggest, both a short term, and a long term plan of action concerning evidence-based **Intervention** strategies; the aim(s) here should be to achieve specific, measurable, attainable, relevant, and time-bound biomechanic goal(s) within an effective period of time; refer to *Chapter 6* for details.

Finally, once the immediate issue(s) have been resolved, the individual enters into the **Prevention Stage**, where the aim(s) of the therapist is to minimize future re-injury risk(s), as much as possible, through long term exercise programming, patient education, and self-care methods.

2.2 DIAGNOSIS… INCLUSIVE OR SPECIFIC?

While the foundations of The MSK-FP Method was being formulated, one of the initial questions that needed answering was whether this system of operation was going to conform to a Diagnosis-Inclusive or to a Diagnosis-Specific system of care.

Sue Falsone, an American Athletic Trainer, aided to define this difference; she defined diagnosis-inclusive as a process by which a medically rendered diagnosis is taken into consideration, however any employed intervention aim(s) to modulate pain and restore functional limitations to normative ranges, as much as possible. [95] On the other hand, any intervention(s) implemented within a diagnosis-specific model of care is solely guided by the structural diagnosis rendered. [95]

It's important to note that both diagnostic perspectives can be considered evidence-based, should the practitioner in question follow established evidence-based clinical guidelines and strategies.

With that in mind, it was subsequently decided that The Musculoskeletal Functional Performance Method of Assessment and Intervention; whilst operating within the scope provided to Osteopathic Therapists, which involves providing "patient-centred whole body approaches to health care **for functional improvement and pain relief**"; [1] will operate as a system of care that allows therapists to objectively classify structural and functional limitations, with the end goal of guiding intervention decisions, thereby aiding in the **reduction of pain** and in the **restoration of human function**.

2.2.1 DEFINING EVIDENCE-BASED PRACTICE

Because of this, The MSK-FP Method aligns itself as a diagnosis-inclusive system of care. However, prior to deriving best evidence-based clinical guidelines and strategies concerning this model, a general understanding of evidence-based principles needed to be demarcated; which involves the culmination and intersection of three major components: *research evidence*, *clinical expertise*, and *patient perspectives*:

Research Evidence can be defined as empirical observations concerning the apparent relationship between events that can be analyzed, sorted, and/or displayed and communicated. [95]

Clinical Expertise, on the other hand, involves the combination of theoretical and practical knowledge accumulated from clinical experience with applications in patient contexts. [95]

Finally, **Patient Perspectives** can be defined as attitudes, beliefs, values, preferences, expectations, and/or motivations that individuals maintain. [95]

While the individual components of evidence-based principles are clearly defined, how these elements actually intersect in real world scenarios is a much more complex and uncertain process.

Nevertheless, because of this fundamental understanding; in many clinical scenarios and cases, clinicians have concluded that there exists no one "best" intervention methodology or strategy. [95]

In fact, Dr. Karel Lewitt and Dr. Vladmir Janda have chosen to describe clinical practice quite poignantly:

[95] Thoughts of Dr. Karel Lewit

WE WORK AT A LEVEL OF ACCEPTABLE UNCERTAINTY

2.2.1.1 EVIDENCE-BASED APPROACH TO CARE

Keeping in mind the symbiotic relationship between the components of evidence-based practice; and as mentioned throughout *Section 2.1*; The MSK-FP Method itself was designed with the capacity to assess key factor(s) of biomechanical health; with the assessment process being capable of tracking objective baseline measurements over the course of the entire intervention process, whilst simultaneously considering the implications of possibly rendered medical diagnoses.

In an effort to define which factor(s) however should form the foundations of the assessment process, one fundamental question, initially, needed answering:

WHAT PARAMETERS ALLOW FOR PAIN-FREE MOVEMENT AND SUBSEQUENT PHYSICAL HEALTH?

In simpler terms:

WHAT MAKES UP PAIN-FREE MOBILITY?

2.3 DEFINING PARAMETERS OF MOBILITY

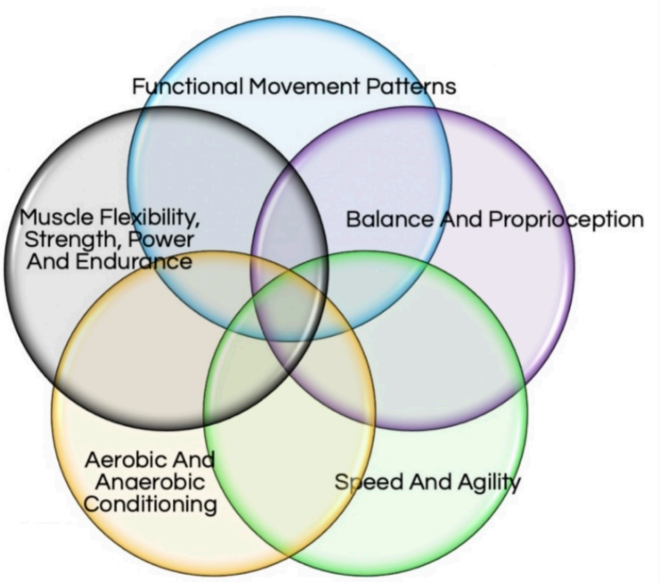
When attempting to broadly define Mobility through the use of dictionaries, it was noted that the Cambridge Dictionary defines mobility as one's ability to "move or [to] be moved freely and easily" [16] while the Merriam-Webster Dictionary defines it as an individual's "quality or state of being mobile or moveable." [15]

Furthermore, when examining how mobility is defined by various health professionals, from various sectors within the Physical Medicine industry, it's observed that Dovan, for instance, defines mobility through three major capacities: *range of motion*, *motor control*, and *strength*. [4]

Comparative to Reiman and Manske whom define mobility through five main capacities, which includes: "*functional movement patterns*", "*muscle flexibility*, *strength*, *power*, and *endurance*", "*balance and proprioception*", "*aerobic and anaerobic conditioning*", and "*speed and agility*".

As referenced in *Diagram I.*

[33] Diagram I - Reiman & Manske, 2009



Reiman & Manske, 2009

While keeping Dovan's, Reiman's, and Manske's modus operandi concerning human movement in mind; whilst also simultaneously considering Human Kinetics, as discussed throughout *Section 1.3.4*; five key capacities have been identified which allow humans to move "freely and easily"; best described as:

- Flexibility
- Balance and Proprioception
- General Strength
- Power
- Endurance Strength

2.3.1 DEFINING FLEXIBILITY

Flexibility, as defined by UC Davis Sports Medicine, is the "ability of a joint or [a] series of joints to move through an unrestricted, [and] pain free range of motion." [17]

When a joint becomes inflexible, it is known to negatively impact the health of surrounding cartilage and other structures within its vicinity that natively requires both: a healthy supply of blood, and nutrients. Generally speaking, deficits in flexibility may cause muscles to tire more quickly because it causes antagonistic muscle groups to work harder, as well as imposes abnormal stresses on structures distant to the site of initial inflexibility. [17]

On account of this, the risk of potential muscular injuries and/or insufficiencies caused by a protective joint mechanism is greater during states of inflexibility.

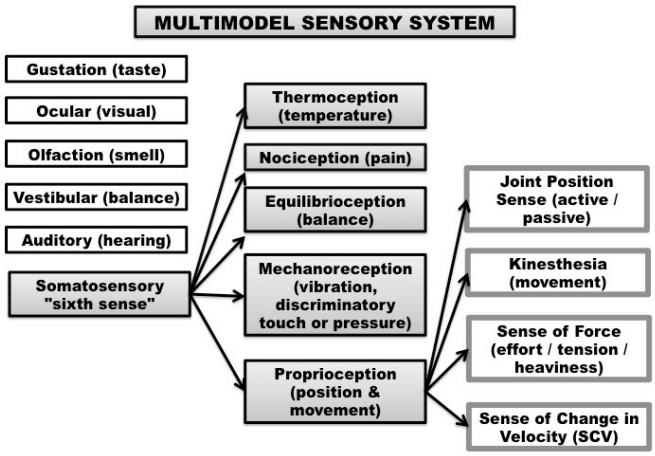
As such, flexibility should be considered foundational when attempting to define key components of mobility.

2.3.2 DEFINING SOMATOSENSORIES

Balance and Proprioception, on the other hand, are defined as neurological concepts which are considered to be two separate components of the Sensory System; they are specifically categorized as components of the Somatosensory Branch of the Sensory System.

As referenced in *Diagram II*.

[21] Diagram II - Multimodel Sensory System



Balance can be defined as the ability to maintain equilibrium, also known as an individual's equilibrioception. This is achieved thanks to inputs from the Proprioceptive System, Vestibular System, and Visual System sending orientation feedbacks to the Central Nervous System which subsequently releases corrective feedbacks that selectively activate muscular stabilizing torques, effectively canceling all reacting forces against each other, which results in a stable balanced system. [18]

Proprioception on the other hand, can be defined as a neuromuscular sense that is understood through four main neural inputs:

(i) *Joint Position Sense* plays a roll in determining the ability to perceive a joint angle and reproduce it, either actively or passively. [22]

(ii) *Kinaesthesia* refers to the awareness of motion in the human body; specifically related to joint movement, as well as in the duration, direction, amplitude, speed, acceleration, and timing of any given motion(s). [22] [23]

(iii) *Sense of Force* is the ability of the body to reproduce or match a desired level of force, one time, or multiple times thanks to afferent feedback

mechanisms of golgi tendon organs, which work alongside muscle spindles and proprioceptors. [24]

(iv) Finally, one's *Sense of Change in Velocity* refers to the ability of the body to detect vibration traveling through afferent nerve fibres. [25] [26]

The sum of these neural inputs, which includes: *neural input i*, *neural input ii*, *neural input iii*, and *neural input iv* from joint capsules, ligaments, muscles, tendons, and the skin influences behaviour regulation and motor control allowing individuals to achieve meaningful interactions with their environment, while also simultaneously avoiding injury. [27]

2.3.3 DEFINING STRENGTH

Next, Strength, as a concept, can be sub-divided and defined through three main sub-categories: *General Strength*, *Power*, and *Endurance Strength*.

2.3.3.1 DEFINING GENERAL STRENGTH

According to Healthline, General Strength refers to an "ability to move or to lift objects" [28], in other words, one's ability to overcome resistance. This can be measured as the amount of force an individual exerts comparative to the amount of weight said individual can lift.

When general strength is improved, improvements can simultaneously be seen in balance, posture, and coordination; while potentially, decreases can be seen in one's risk(s) of injury, in bone loss, and in aging related muscle loss. [28]

2.3.3.2 DEFINING POWER

Power, on the other hand, can be defined as an individual's ability to overcome resistance in the shortest amount of time possible. [29] [30]

2.3.3.3 DEFINING ENDURANCE STRENGTH

And moreover, Endurance Strength can be defined as the "ability to keep doing something difficult, unpleasant, or painful for a [prolonged period of] time" [31], or as one's "ability to sustain a prolonged stressful effort or activity." [32]

Simply put, endurance strength refers to the ability of a muscle to sustain repeatable contractions against resistance, over an extended period of time. [28]

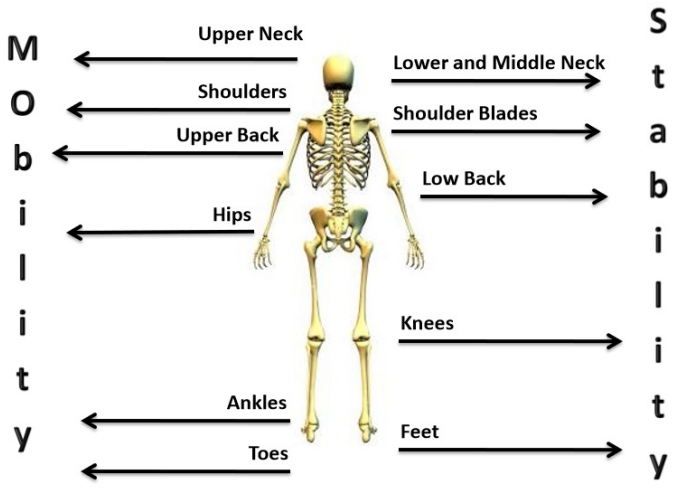
CHAPTER 3 CLINICAL CONCEPTS

Whilst keeping these definitions in mind, the Musculoskeletal Functional Performance Method of Assessment and Intervention is further underpinned by three major clinical theories, and one doctor's key summarizations of clinical biomechanics.

3.1 JOINT BY JOINT THEORY

The *Joint by Joint Theory*, devised by Gray Cook and Mike Boyle, proposes the idea that the body is a "stack of joints [whereby] each [joint has] a specific function [that alternates] between mobility and stability." [4] As referenced in *Diagram III*.

[35] Diagram III - Cook & Boyle



Cook and Boyle have used this theory to propose the idea that each joint is prone to predictable dysfunction(s). [4]

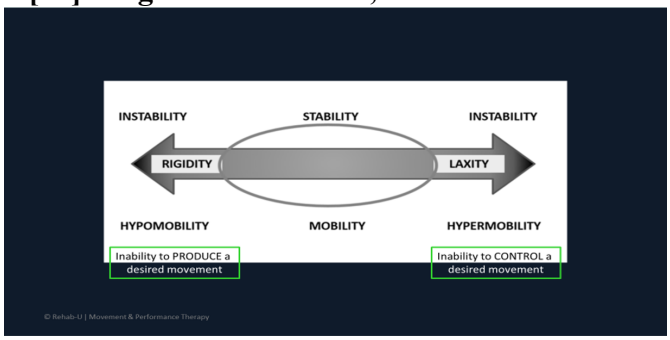
3.2 MOBILITY-STABILITY CONTINUUM THEORY

Furthermore, and interestingly enough; the *Mobility-Stability Continuum Theory*, builds itself off of Cook and Boyle's *Joint by Joint Theory*.

This theory further suggests; from a functional perspective, that a combination of mobility and stability is required in order to maintain healthy human function. [77]

It suggests that too much stability can create hypomobility, which then can result in an inability to produce movement; while on the other hand, too much mobility can result in hypermobility, which subsequently, can cause individuals to become unable to control movement. [77] As referenced in *Diagram IV*.

[78] Diagram IV - Dovan, Mob. Fundamentals



Dovan discloses that in either of these cases, whether discussing hypomobility or hypermobility; both can cause a decrease in movement capacity, which she describes as **Functional Instability**.

This phenomenon is stated to cause individuals to suffer from an "inability to dynamically stabilize a joint [thereby affecting their ability to properly control affected area(s), which then subsequently impacts their] movement [capabilities]." [77]

3.3 THEORY OF REGIONAL INTERDEPENDENCE

Lastly, the *Theory of Regional Interdependence* proposes the idea that "the area of complaint is usually not the area where [the] dysfunction [originates], but rather [it is] the area where the dysfunction has caused a breakdown." [4] [105]

This breakdown can include:
pain, *injury*, and/or a *syndrome*.

This indicates that therapists should not only assess the site(s) of initial complaint; but rather, therapists should also take into consideration the structures and the functioning of joints and muscles above and below the region(s) of complaint.

3.4 SUMMARIZING BIOMECHANIC PRINCIPLES

By examining human movement, also referred to as human kinetics, through these outlined osteopathic perspectives, while also keeping in mind the clinical concepts and theories proposed; it can be concluded that both muscles and joints serve as the structural foundations for which human movement occurs.

Because of this, dysfunctions are capable of arising from either of these sources. [4]

Dr. John M. Mennell summarizes the relationship of muscles and joints; with regards to biomechanics and human movement quite accurately:

- Should a joint not be free to move; subsequently, the muscles that are said to move that joint are also not free to move. [36]

- Muscles cannot be restored to normal if the joint which they move is incapable of moving. [36]

- Normal muscle function and normal joint movement are interdependent. [36]

- And, an impairment in muscle function subsequently perpetuates and may cause

deterioration(s) in abnormal joint(s); and vice versa. [36]

In simpler terms, in order to understand which area(s) of mobility are playing a role in the impairment; the overall structures, alongside the way the human body is currently functioning should be considered; to that end, the musculoskeletal system should be objectively evaluated qualitatively and quantitatively, as both methodologies working together offer insights into probable cause.

CHAPTER 4 MSK-FP : ASSESSMENT

The pressbook, *Physical Examination Techniques: A Nurse's Guide* by Jennifer Lapum et al aided to define the foundations of the MSK-FP assessment process; Lapum defines examination as a process of determining "normal and abnormal findings. [With] abnormal findings [cuing] a potential concern" [76].

Ergo, the aims of The MSK-FP Method is to collect qualitative and quantitative information concerning the individual's physical presentation(s); which, should be observable and measurable. [76] Simultaneously, tests used during this process should be reproducible, and research should indicate that the methods themselves show clinical significance.

Because of this, individuals should be examined in all "planes of movement, [their] bracing strategies [should be taken into account], [the] open kinetic chain [should be assessed comparative to the] closed kinetic chain, [and movements should be assessed in isolation against their] compound" variants. [4]

Should clinicians fail in assessing, and subsequently analyzing the results obtained concerning *Flexibility*, *Balance*, *Strength*, *Power*, *Endurance*; and possibly *VO_2Max*, in athletic specific populations; prior to the rendering of a clinical impression; clinicians will fail in the setting up of physical baseline metrics, and therefore, in consequence, clinicians will be unable to understand if a presenting dysfunction is structural in origin or if it is functional.

To quote Steven King, PT, DO from the Movement Assessment Technologies group: "IF YOU'RE NOT ASSESSING, YOU'RE GUESSING."

4.1 INTRODUCING THE ASSESSMENT PROCESS

While the traditional osteopathic assessment process operates within the S.O.A.P. framework; said model contrasts Physical Therapy and Nursing whom currently operate under an enhanced model, colloquially referred to as S.O.A.P.I.E.R. This augmented framework of evaluation involves seven key steps of operation rather than four: **Subjective**, **Objective**, **Analysis**, **Plan of Action**, **Intervention**, **Evaluation**, and **Revision**; as such, it was decided upon to amalgamate this seven step framework into the four main stages of The MSK-FP Method, rather than relying solely on the basis of the original S.O.A.P. format; with regards to clinical operations.

To that end, in an effort to guide the collection of both, qualitative and quantitative data sets; the MSK-FP assessment process is explained as a trifold structure; as referenced in *Figure II*.

THE MSK-FP METHOD

THE ASSESSMENT PROCESS

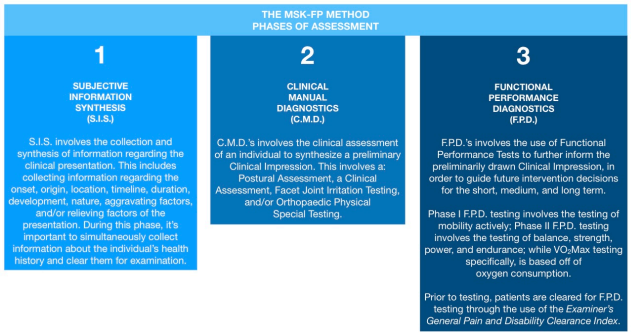


Figure II
The MSK-FP Method
The Assessment Process
as Proposed by Antonio Marcello Colasurdo

The remainder of this dissertation, encompassing *Chapters 4* through to *Chapter 7*, will discuss the integrations of S.O.A.P.I.E.R., as well as clinical guidelines and strategies implemented with regards to the Musculoskeletal Functional Performance Method of Assessment and Intervention.

4.2 SUBJECTIVE INFORMATION SYNTHESIS

The assessment process itself begins with a synthesis of a patient's health history, including a discussion of previous and/or current injury experiences; this aids in the consideration of tests and/or assessment processes; whilst simultaneously aiding in keeping all testing protocols selected, clinically relevant.

A subjective recounting of the reasoning for consultation typically involves a collection of information regarding **onset**, **origin**, **location**, **timeline**, **duration**, **development**, **nature**, **aggravating factors**, and/or **relieving factors**, with relation to the current pain, injury, and/or syndrome.

Once the information has been tabulated, the therapist should then decide which assessments are required to inform their clinical impression; and simultaneously, which tests are required to set up objective baseline metrics concerning said physical presentation(s).

Ten key area(s) of testing and assessment have been identified throughout the research process, which can help guide therapists to develop their clinical impression, and subsequent intervention strategies:

- Postural Assessment
- Clinical Assessment
- Facet Joint Irritation Testing
- Orthopaedic Physical Special Testing
- Active Mobility Testing
- Balance and Proprioception Testing
- General Strength Testing
- Power Testing
- Endurance Strength Testing
- Predictive VO_2Max Testing

When referencing back to *Figure II*, on the previous page, it should be noted that each of these ten key area(s) of testing can either be considered a component of the *Clinical Manual Diagnostics* or the *Functional Performance Diagnostics* phase of assessment.

4.3 EXAMINER'S GENERAL PAIN AND DISABILITY CLEARANCE INDEX

Preceding the assessment process however, therapists are first required to clear patients regarding physical safety. In an effort to help guide this decision, the *Examiner's General Pain and Disability Clearance Index* has been devised.

Therapist begin this authorization process by first inquiring into the individual's current level of pain and/or discomfort experienced, subsequently grading said pain on a scale from zero to ten, with zero indicating no pain and ten indicating the worst level of pain imaginable.

In addition, the therapist will subsequently need to grade the individual's current level of disability on a scale of zero to five.

- A patient who is *Graded 0* according to this scale is an individual who experiences no pain, in relation to their dysfunction. These individuals are cleared for all forms of assessment and testing, which may include Predictive VO_2Max Testing, should the individual in question fall into the athletics category.

- An individual who is *Graded I* according to said scale is an individual who experiences low levels of pain, and whom is negligibly disabled. These individuals are cleared for all forms of testing, excluding Predictive VO_2Max Testing; unless the individual is an athlete whom is preparing to return to sport.

- A patient who is *Graded II* according to this index is someone who experiences low levels of pain and disability. These individuals are cleared for all forms of assessment and testing, excluding Predictive VO_2Max Testing; so long as the tests themselves do not aggravate the dysfunction(s) further.

- A patient who is *Graded III* according to said index is someone who experiences high amounts of pain, as well as someone whom is highly disabled on account of their physical presentation(s). These individuals are cleared for *Clinical Manual Diagnostics*; however, they may only be cleared for *Functional Performance Diagnostic* active mobility testing, so long as the tests themselves do not aggravate the dysfunction(s) further.

- Moreover, a patient who is *Graded IV* according to this scale is an individual who experiences high levels of disability, and whom is moderately limited in their day to day activities. These individuals may only be cleared for *Clinical Manual Diagnostics*; however they may also potentially be cleared for *Functional Performance Diagnostic* active mobility testing, so long as the tests themselves are within the capabilities of the individual to execute, and so long as the tests selected do not aggravate the dysfunction(s) further.

- Lastly, a patient who is *Graded V* according to said scale is someone who experiences high levels of disability, and whom is severely limited in their day to day activities. These individuals may only be cleared for *Clinical Manual Diagnostic* testing.

By employing this index, therapists become capable of making informed decisions, regarding which tests and assessments ought to be considered safe; for the patient to take part in.

In regards to assessment and testing procedures themselves; these processes can be split into four major evaluation categories:

- **Fundamental Assessments** involve a Postural Assessment, a Clinical Assessment, Facet Joint Irritation Testing, and/or Orthopaedic Physical Special Testing.

- **Phase I Testing** includes Active Mobility Testing.

- **Phase II Testing** involves Balance and Proprioception Testing, General Strength Testing, Power Testing, and/or Endurance Strength Testing.

- and **Predictive VO_2Max Testing** involves, as the name implies, VO_2Max Testing.

Once clearance by the *Examiner's General Pain and Disability Clearance Index* is achieved; and once the assessments and physical tests to be performed have been selected, The MSK-FP assessment process itself can officially, and safely, begin.

4.4 CLINICAL MANUAL DIAGNOSTICS

Clinical Manual Diagnostics involves the use of all traditional forms of osteopathic assessment normally performed within a clinical context. This includes a: Postural Assessment, a Clinical Assessment, Facet Joint Irritation Testing, and/or Orthopaedic Physical Special Testing.

That said, whilst all forms of traditional osteopathic assessment are retained as components of the *Clinical Manual Diagnostics* phase of assessment; subsequently, the MSK-FP system of care requires therapists to make use of *Functional Performance Diagnostics*, as referenced in *Section 4.1*, and as discussed in *Section 4.5*; which are designed to further inform a working clinical impression, as active functional performance testing may influence the impression drawn, and the intervention strategy selected; as discussed in *Chapter 6*.

4.4.1 POSTURAL ASSESSMENT

As explored throughout *Evidence-Based Manual Medicine*, *A Problem-Oriented Approach*, a Postural Assessment "entails [the] observation of static posture for alignment, [as well as a] visual and [a palpation] assessment of paired anatomic landmarks for symmetry." [79]

While included as a component of The MSK-FP Method, and while postural deviations themselves have been linked to a series of orthopaedic and rheumatologic diseases, the study of posture, in of itself, remains clinically difficult because of practitioner error. [80]

As such, the assessment of posture should be considered only a singular component of a larger clinical evaluation process, rather than a standalone diagnostic assessment tool.

4.4.2 CLINICAL ASSESSMENT

Sequentially, the Clinical Assessment process itself is a multi-faceted evaluation procedure, involving the combination of musculoskeletal palpation, facet joint irritation testing, and/or orthopaedic physical special testing. This process aids clinicians in the formulation of a working clinical impression; and may indicate whether a clinical presentation contains nociceptive, neurologic, or nociplastic components.

4.4.2.1 MUSCULOSKELETAL PALPATION

Musculoskeletal Palpation is defined by the MedlinePlus Medical Dictionary as a method by which a clinician utilizes their fingers or hands during a physical examination to evaluate the size, consistency, texture, location, and tenderness of a body part. [82]

This method is utilized to assess tissue texture, and aids in locating area(s) of pain and/or discomfort within the tissue(s), as well as may aid in locating possible patterns of pain referral.

4.4.2.2 FACET JOINT IRRITATION TESTING

Facet Joint Irritation Testing, on the other hand, is a process by which a clinician palpates a spinal facet joint, applying a posterior to anterior direction of force. This is considered to be a provocational test who's goal is in detecting pain that is suggested to be caused by irritation at said facet joint.

Should pain be found to radiate into an arm or a leg, this may subsequently indicate a nerve root irritation, thereby indicating for the use of orthopaedic physical special tests.

4.4.2.3 ORTHOPAEDIC SPECIAL TESTING

Moreover, Orthopaedic Special Testing, also referred to as Orthopaedic Examination Special Tests and/or Orthopaedic Physical Special Testing, are used by clinicians to rule in or to rule out specific musculoskeletal dysfunctions, such as nerve impingements. As mentioned in *Section 4.4.2.2*, these special tests are indicated in cases where facet joint irritation testing reveals referral patterns of pain, which leads into a limb.

4.4.3 CONCLUSIONS ESTABLISHED BY C.M.D.'S

Once all forms of *Clinical Manual Diagnostic* testing is completed, as outlined in *Figure II*, and discussed throughout *Section 4.4*; therapists may begin formulating a working clinical impression.

At this stage, clinicians should make use of *Functional Performance Diagnostics*, in an effort to enhance the preliminarily drawn clinical impression, so long as the testing processes themselves are considered safe to partake in, as referenced in *Section 4.3*.

The purposes of *Functional Performance Diagnostic* testing involves the informing of a working clinical impression, as well as aids in the setting up of objective baseline metrics, which then become capable of being tracked over the entire course of the intervention process; this is important as it

subsequently aids in validating if a chosen intervention method is truly having positive outcomes on a clinical presentation; refer to *Chapter 5* and *Chapter 6* for details.

4.5 FUNCTIONAL PERFORMANCE DIAGNOSTICS

As mentioned throughout *Section 1.2.2*, one of the philosophical premises Dr. Still taught, with concerns to Osteopathy, involves the interrelation of structure and function; and as discussed in *Section 3.4*, both structure and function have the capabilities to influence each other.

Therefore, it should be considered clinically relevant to, not only, evaluate the structures of the body through the use of *Clinical Manual Diagnostics*; but rather to also subsequently evaluate the functioning of the body through *Functional Performance Diagnostics*; which "Reiman and Manske [describe] as a [process whereby the clinician investigates the] capabilities [of human] movement [as well as] optimized athletic performance." [34]

The goal(s) of this phase, of the assessment process, is to empower therapists with active forms of testing that garner objective metrics, which simultaneously have the capacity to reveal possible limb symmetry discrepancies, as well as reveal possible functional limitations in *Flexibility*, *Balance*, *Strength*, *Power*, and *Endurance Strength*; comparative to normative ranges established in musculoskeletal research.

4.5.1 FUNCTIONAL EVALUATION KEY AREAS

When discussing functional evaluations, the human body can be seen to be sub-divided into three distinct systems of function: the *lower chain*, the *axial skeleton*, and the *upper chain*.

4.5.1.1 THE LOWER CHAIN

The Lower Chain consists of the ankle joint, the knee joint, and the hip complex.

The ankle itself has the capacity to create effective movement patterns, and is considered to be the site where initial movement begins and load is initially absorbed for upright function. [34]

The knee, as Cook and Boyle describe, is considered to be a site of stability in the body who's main role is to flex and extend; whilst working alongside the ankle joint in absorbing load, in upright function. [34]

Finally, the hip complex is considered the superior-most component of the lower chain; containing the strongest muscles of the human body that surrounds a complex ball and socket joint; this region of the lower chain has the capacity to move in all three planes of movement. [34]

From a therapeutics perspective; the health of the ankle, knee, and hip complex is critical, as an inability to control gravitational forces and load may subsequently lead to issues throughout the lower chain, or it may also subsequently produce issues further up the chain, into the axial skeleton. [34]

4.5.1.2 THE AXIAL SKELETON

The axial skeletal region itself contains quite a number of common sites of disability, specifically with regards to spinal and back pain related issue(s). In fact, these issue(s) have become quite prevalent throughout modern society.

For instance, a 2018 study published in the Lancets revealed that the amount of years individuals live with disability caused by low back pain has increased by more than 50% since the 1990s. [34]

Ergo, because of the possibility of dysfunction arising within the axial skeleton, it becomes prudent to include a complete functional spinal evaluative component within the *Functional Performance Diagnostics* phase of assessment.

4.5.1.3 THE UPPER CHAIN

Lastly, the upper chain consists of a complex junction at the shoulder; which is composed of four articulating surfaces, three major tendons, and over eighteen muscular attachment points that have the capabilities of influencing the cervical spine, the thoracic spine, and the hip complex. [34]

In fact, shoulder related pains and/or injuries may actually be correlated to the sheer complexity of the joint structure itself. [34] This specific correlation may also correspond and be explained through the *Mobility-Stability Continuum Theory*, whereby, because the joint structure is considered to be, potentially, a site of hypermobility, it potentially then may result "in [an] inability to control movement", [77] which subsequently, may expose the individual to an increased risk of injury.

With this in mind, therapists should help patients increase dynamic stability at said joint structure, thereby allowing individuals to develop a proper level of control and movement skill; in turn, this may subsequently decrease the likelihood of a future structural-related injury at this location. [77]

4.5.2 PHASE I TESTING (FUNCTIONAL MOBILITY)

As discussed throughout *Section 4.3*, in an effort to help maintain patient safety; it is recommended that a trifold system be implemented with regards to functional performance testing specifically.

Phase I Testing, for instance, should solely be utilized in cases whereby individuals are *Graded 0 to IV* by the *Disability Index* component of the *Examiner's General Pain and Disability Clearance Index*.

4.5.2.1 MOBILITY TESTS

Mobility tests, also known as Active Flexibility Tests, are designed to assess the available level of active flexibility at a given joint; while also allowing therapists to qualitatively assess the individual's ability to move said joint through its normally available range of motion.

Tests may include:

- A **Weight-Bearing Lunge Test** (WBLT), which has the capacity to assess the tibial inclination of the foot, as well as the ankle's capabilities during active dorsiflexion. [34]

- A **Hip Internal Rotation Test**, which, on the other hand, assesses, as the name implies, the internal rotation capacity of the hip complex. [34]

- And, **Shoulder Mobility Tests**, which, assess the functional capabilities of the shoulder complex to move through different planes of motion; this includes: flexion, extension, abduction, adduction, ninety-degree internal rotation, and ninety-degree external rotation. [34]

While this list of tests is non-exhaustive, it does give clinicians a starting point, with regards to how they may build out a flexibility evaluation process.

4.5.3 PHASE II TESTING (BALANCE, STRENGTH, POWER, ENDURANCE)

Sequentially, the next phase of testing is Phase II; which is generally recommended solely for individuals who've *Graded 0 to II*, as cleared by the *Disability Index* component of the *Examiner's General Pain and Disability Clearance Index*.

Individuals indicated for *Phase II Testing* are likely to experience discomfort, as testing itself may aggravate an issue and/or dysfunction; therefore, it becomes the clinician's role to work within the pain and/or discomfort tolerance threshold levels of the

individual during testing, should the individual in question experience high levels of pain, discomfort, and/or disability on account of their clinical presentation(s) during active movement.

4.5.3.1 BALANCE TEST

Balance, for instance, may be assessed through the use of a **Star Excursion Balance Test** (SEBT).

Research has shown that this form of testing has the capabilities to evaluate the individual's available level of flexibility, strength, balance; as well as movement skill, and low levels of limb loading and function across the lower limb, and the trunk. [34]

The SEBT can also be considered a secondary line of clearance testing, to further determine patient safety, prior to progressing individuals towards unilateral lower limb strength testing. [34]

4.5.3.2 STRENGTH AND ENDURANCE TESTS

Following a star excursion test, clinicians can begin the process of strength and endurance testing; again; should the patient be considered a safe candidate.

These tests can include:

- A **Single Leg Calf Raise Test**, which has the capacity to assess the calf complex, as well as the overall endurance strength of the lower shank. [34]

- **McGill's Torso Endurance Tests**, which are considered to be a staple for the assessment of the trunk's flexors, extensors, and oblique muscles. [34]

- and/or a **Closed Kinetic Chain Upper Extremities Test** (CKCUET), which has the capacity to assess the upper limb's capabilities to tolerate stresses and strains. [34]

4.5.3.3 POWER TEST

Moreover, a **Broad Jump Test** may be considered a beginner level power assessment screen, which can safely monitor a patient's capacity to perform plyometric type movements before considering to progress the difficulty of testing further.

At it's core, this power test is used to assess athletic capabilities. [34]

As previously mentioned in *Section 4.5.2.1*, while this list of tests is not exhaustive; it gives therapists a foundational starting point with regards to how they may build out strength, balance, power, and endurance functional performance testing protocols.

4.5.4 PREDICTIVE VO_2MAX TESTING

Lastly, should the individual be considered a recreational and/or professional athlete; and/or should the intervention process enter into *Phase III* as will be discussed in *Chapter 6*, which involves a return to sport protocol; the patient may be indicated for Predictive VO_2Max Testing. This testing protocol however is solely indicated in individuals whom are *Graded 0 to I* by the *Disability Index* component of the *Examiner's General Pain and Disability Clearance Index*.

Predictive VO_2Max Testing can be utilized to estimate an individual's aerobic capacity, by approximating the maximal amount of oxygen consumption attainable during physical exertion.

Testing itself involves collecting information related to the individual's **age**, **weight**, and **resting heart rate**; as well as collecting information regarding the **average heart rate of the individual during a sub-maximal aerobic test** and the **average heart rate of the individual during a maximal aerobic test**.

With this information, clinicians can use predictive mathematical equations to calculate the individual's predictive level of VO_2Max.

CHAPTER 5 MSK-FP : ANALYSIS

Once the assessment process has concluded, and all forms of indicated testing have been completed; the dissemination and analysis of all collected information can begin. This process involves a *Pain Screening Analysis*, a *Musculoskeletal Functional Performance Analysis*; and when working with athletic populations specifically, a *Predictive VO_2Max Analysis*.

Once all three stages of analyses have concluded, the therapist is then subsequently required to formulate a clinical impression, which summarizes their observations surrounding the clinical presentation(s), as referenced in *Figure III*.

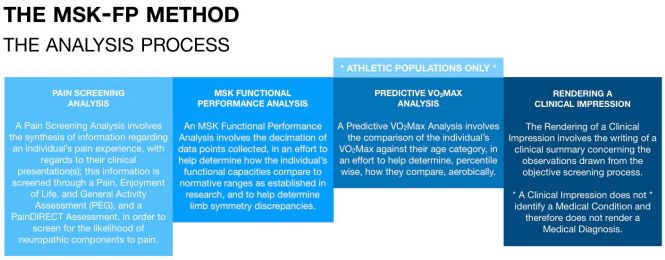


Figure III
The MSK-FP Method
The Analysis Process
as Proposed by Antonio Marcello Colasurdo

5.1 PAIN SCREENING ANALYSIS

A Pain Screening Analysis involves the dissemination of information collected by three patient self-assessment questionnaires.

A **Pain, Enjoyment of Life, and General Activity Questionnaire** (PEG) involves three, zero to ten pain scale questions, with regards to, as the name implies; pain, enjoyment of life, and one's abilities regarding general day to day activities.

Next, a **PainDIRECT Questionnaire** involves collecting information with regards to the nature of the individual's pain experience. Said pain is subsequently scored on a scale of zero to thirty-eight depending upon the answers given; which helps to determine the likelihood of nociceptive, neuropathic, or nociplastic components; regarding pain phenotype; with up to a 90% in accuracy.

Lastly, a **Patient Health Questionnaire-4** (PHQ-4) is used, in an effort to help determine the probability of whether the injury experience itself, potentially, is having a psychological influence on the individual's enjoyment and quality of life.

5.2 MSK FUNCTIONAL PERFORMANCE ANALYSIS

Once the likelihood of nociceptive, neuropathic, and/or nociplastic components, with regards to pain has been established; an MSK Functional Performance Analysis aids in determining whether, objectively speaking, deficits in the various components of mobility can been witnessed. This involves the dissemination of all functional performance information collected, in the form of data points; which is subsequently compared to normative ranges that musculoskeletal research establishes.

This includes analyzing data points collected concerning an individual's *Flexibility*, *Balance*, *Strength*, *Power*, and *Endurance*; which can also aid in determining the individual's potential risk(s) of future injury.

The Pan American Health Organization defines this process of analysis, as an evaluation concerning "the probability and consequences of injury or an event arising from exposure to [identifiable] risks." [83]

With regards to The MSK-FP Method, specifically as implemented into Osteopathic Therapy; all utilized forms of assessment and testing aims to help identify biomechanic discrepancies, as compared to normative ranges, which are identified within musculoskeletal research; as **area(s) of potential concern** and **area(s) of potential improvement**.

This process of analysis also aids therapists in the setting of objective baseline measurements, which can be subsequently re-tested over the course of the entire intervention process, thereby helping to validate whether a chosen intervention method is garnering objectively beneficial outcomes, with regards to a patient's physical presentation(s).

5.3 PREDICTIVE VO_2MAX ANALYSIS

Next, if indicated, and prior to the rendering of a clinical impression; the results gathered by a Predictive VO_2Max Test should be compared to normative standards established by research bodies; such as Statistics Canada, regarding the *Normative-Referenced Percentile Values for Physical Fitness Among Canadians*, for instance. [106]

These normative values will aid in the analysis of how tested individuals fair, with regards to their VO_2Max; compared to their age category.

Once both data sets have been tabulated and analyzed, a clinical impression is needed to be rendered, regarding the individual's clinical presentation(s).

5.4 RENDERING A CLINICAL IMPRESSION

Law Insider defines a Clinical Impression as a "written summary of [the] observations and conclusions" a clinician draws from the objective screening process conducted by said clinician, within the scope of their training. [84]

With that in mind, it's important to note that a clinical impression rendered as a part of The MSK-FP Method differs from a Medical Diagnosis, as the impression itself is a written summary of the results obtained throughout the assessment and analysis processes; alongside recommendations made by the therapist who performed the assessment; this information however should be considered a snapshot view into which tissues are sensitized, how pain is reacting in the body, and how the body is currently performing biomechanically, comparative to normative ranges established in research.

For instance, information summarized within said clinical impression may involve details surrounding a location of pain with potential referral patterns, it may detail functional performance deficits uncovered in flexibility, balance, strength, power, and/or endurance, as compared to normative ranges identified in musculoskeletal research, and it may detail excessive limb symmetry discrepancies in mobility uncovered throughout the testing process.

This information however, does not identify a medical condition; as such, the Musculoskeletal Functional Performance Method of Assessment and Intervention does not have the intrinsic capacities necessary, in of itself, to render a medical diagnosis.

Rather, the goal(s) of the assessment and analysis processes is to locate source(s) of pain and/or discomfort; locate possible neural referral patterns with regards to pain and/or discomfort; identify abnormal tissue tonicity and possible discrepancies in posture; identify functional performance deficits in flexibility, balance, strength, power, and endurance; identify excessive functional limb symmetry discrepancies; and should a medical diagnosis be rendered prior to the consultation process, identify how the possible pathologies may be affecting the patient, from a functional performance perspective.

CHAPTER 6 MSK-FP : INTERVENTION

These primary stages of The MSK-FP Method then, subsequently inform the intervention process; both, during the initial stage, in an effort to help determine how the practitioner in question should proceed; as well as throughout the entire course of treatment; until the case is brought to it's completion, which

helps to validate whether selected methods of intervention are truly having desirable outcomes on clinical presentation(s).

That said, the process of intervention itself, can be defined as the act of interfering, or interceding; with the intent of modifying a perspective outcome. [87] Medically speaking, an intervention is undertaken to treat and/or to cure a medical ailment; however, operating within a therapeutics framework; interventions are undertaken to stimulate the body's innate healing processes which can include processes and/or techniques that **modulate pain perception**, **normalize muscle tone and/or neuronal activity**, and/or processes and/or techniques which **stimulate muscular adaptations** in the body allowing it to strengthen over time.

These three goal(s) form the backbone of the MSK-FP intervention process; which subsequently raises a question:

HOW DOES A THERAPIST SELECT, THE MOST APPROPRIATE, INTERVENTION MODALITY, FOR A PATIENT'S CLINICAL PRESENTATION(S)?

6.1 PLAN OF ACTION AND GOALS OF THERAPY

Prior to the selection of an intervention modality, all MSK-FP intervention processes begin with the drafting of a Plan of Action; which should involve correcting deficits uncovered concerning mobility, that were previously identified throughout the assessment process, and quantified throughout the analysis process.

The plan of action itself should identify goal(s) that are **Specific**, **Measurable**, **Achievable**, **Relevant**, and **Time-Bound**; which in addition, said goal(s) should be organized into actionable steps for the short term, the medium term, and for the long term.

These plans should help to decrease and/or eliminate pain, they should help to restore mobility, and they should help to restore functional performance to athletic individuals, whether it be a casual athlete or a professional one, so as to return them to sport.

These goal(s) are achieved by helping individuals develop:

- **Movement Capacity**, which includes developing all the key factor(s) that makes up mobility and healthy human function; as defined in *Section 2.3*. [34]

- **Movement Competency**, which can be defined as developing the skills required to perform complex movement patterns efficiently. This can include the development of: *balance*, *movement control*, and *movement synchronicity*. [34]

- **Movement Variability and Variety**, which can be thought of as the ability to perform movement patterns in different manners; as well as with different loads, speeds, angles, heights, distances, and in different environments. [34]

- As well as **Confidence**, which, behaviourally speaking, influences how individuals move. For instance, Pain Adaption Syndrome (PAS) has the capacity to fundamentally alter movement patterns and/or muscular activations; as a consequence, PAS may play a role in producing area(s) of instability in the human body, with regards to mobility. [4] [34]

Because of this, the long-term success of an MSK-FP intervention hinges on the development of movement capacity, movement competency, movement variability and variety, confidence, and on the de-programming of PAS adaptations.

6.2 INTRODUCING THE INTERVENTION PROCESS

Therefore, the goal(s), when selecting an intervention modality should be concerned with; which modality will deliver objectively identifiable results, and which modality aligns itself with best evidence-based clinical guidelines and strategies, as established by musculoskeletal research; and as discussed throughout *Section 2.2*, *Section 6.1*, and which will be discussed in *Section 6.3*.

In consideration of this, the MSK-FP intervention process has been divided into two lines of intervention, and sub-divided into three phases of care; with each phase correlating with the achievement of a specific goal.

Refer to *Figure IV* for details.

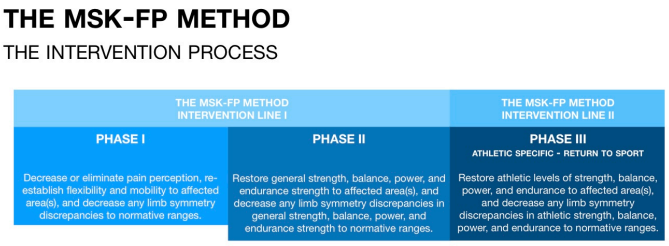


Figure IV
The MSK-FP Method
The Intervention Process
as Proposed by Antonio Marcello Colasurdo

In light of this, any modality of care selected, as a part of the intervention process, should be indicated, and simultaneously, if proper licensure is not had by the practitioner in question, all acts performed should not be considered reserved activities for specific practitioner groups.

For instance, in Canada, reserved activities can include *Spinal Manipulations*, *Dry Needling*, and in select provinces, *Technology-Based Modalities*.

6.2.1 INTERVENTION LINE I

The first line of intervention mainly concerns itself with the decrease and/or with the elimination of pain, and with the restoration of general flexibility, balance, strength, power, and endurance to normative ranges, as well as with the normalization of limb symmetry discrepancies to 10%.

Whilst athletic care and return to sport, on the other hand, are handled within the secondary line of intervention as the building of athletic capacities is considered to be an intensive act; with which foundations need to be built, prior to the commencement of said processes.

6.2.1.1 PHASES OF CARE, LINE I

As mentioned in *Section 6.2*, Line I care can be further segmented into two primary phases of care:

Whereby the goal(s) of **Phase I** would be to decrease and/or eliminate pain perception and/or discomfort, as well as deal with the re-establishment of general levels of flexibility to affected region(s), and with the normalization of limb symmetry discrepancies, in flexibility, to normative ranges.

While the goal(s) of **Phase II** would be to re-establish adequate levels of general strength, balance and proprioception, power, and endurance strength to affected area(s); as well as deal with the normalization of limb symmetry discrepancies in general strength, balance and proprioception, power, and endurance strength, to normative ranges.

6.2.2 INTERVENTION LINE II

Sequentially, once general mobility and function have been re-established, and pain has become manageable; recreational and/or professional athletes will be transferred towards Line II care; which involves the re-establishment of athletic-specific capacities, in an effort to prepare said athletes to

safely return to sport.

As mentioned in *Section 6.2.1*, athletes should begin Line II care, once Line I care has been brought to completion, as Line II care is intensive in nature, as muscular adaptation is the goal, in order to progress the athlete and return them to sport; which, is carried out throughout **Phase III**.

6.2.3 IN SUMMARY

In summary, during the acute phases of care, the goal(s) of intervention would be to decrease pain and inflammation, as well as muscle spasm; while promoting the healing of tissues through sufficient levels of stabilization; and through the increasing of pain-free range of motion, soft tissue extensibility, neuromuscular control, and general weight bearing tolerance (Phase I). [97]

While the goal(s) of subsequent phases of care would be to significantly reduce or completely resolve pain perception, restore full, pain-free range of motion, completely restore gait, where appropriate, and to further restore strength and neuromuscular control (Phase II and Phase III). [97]

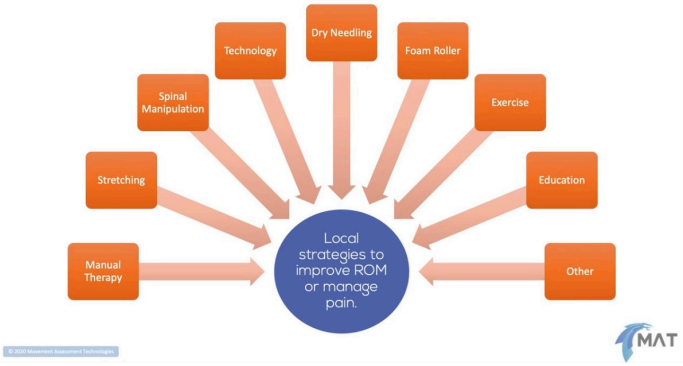
6.3 INTERVENTION MODALITIES

In an effort to achieve these goal(s) however, the intervention method itself would need to involve modalities that are effective, relevant, and evidence-based, with regards to the patient's clinical presentation(s).

The modalities considered for use, and/or selected as a part of The MSK-FP Method should not be considered acts that are reserved activities under law, within the therapist's jurisdiction of practice.

Refer to *Diagram V* for a list of various modalities clinicians may use as a part of clinical practice.

[85] Diagram V - Modalities Defined By M.A.T.



6.3.1 MANUAL THERAPY

As a clinical modality, Manual Therapy can be defined as a broad group of passive interventions in which therapists use their hands to administer skilled movements designed to modulate pain, increase joint range of motion, reduce or eliminate soft tissue swelling, inflammation, or restriction, induce relaxation, improve contractile and non-contractile tissue extensibility, and/or improve pulmonary function. [88]

6.3.1.1 THE GREAT MANUAL THERAPY DEBATE

That said however, there is a great divide amongst different allied health practitioners concerning the inclusion of Manual Therapy (MT) as a viable treatment modality within the scope of physical medicine.

While some practitioners do not agree with including MT within treatment, going so far as to state that there is no room for it within a clinical context; others still, cling to manual therapy as some sort of secret trojan horse, believing it to be the only method of treatment that truly works.

Both of these stances however can be considered incorrect as there exists evidence supporting both of these positions.

When examining the preponderance of evidence

regarding the applications of manual therapy within a clinical context, it was noted that researchers seem to be in agreeance that MT shows potentially beneficial effects. [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61]

That said, certain manual therapy techniques do contain gaps in their individual bodies of literature concerning effective dosing, and at times, positive causal effects still needs to be adequately substantiated. [47] [48] [62] [63] [64] [65]

Furthermore, some studies in particular also suffered from a low strength of evidence caused either by their study design or by the data collection process. [48] [51] [52] [64] [65]

Enlarge however, researchers agree that most MT techniques contain a strong enough evidence to support their use clinically, so long as the techniques selected themselves are incorporated as a part of a larger therapeutic intervention strategy, and not used in isolation. [52] [53] [55] [66] [67] [68] [69] [70] [71] [72] [73] For the simple reason that, at times, causation still needs to be adequately established [55] [57] [59] [66] [74], and potential long term benefits still needs to be adequately investigated. [48] [50] [51] [55] [64] [65] [75]

Furthermore, when comparing the benefits of manual therapy against a more active intervention, such as exercise therapy; researchers seem to agree that while MT is able to achieve "faster [reductions] in pain perception" when compared to ET, exercise therapy is able to reduce disability quicker, as opposed to MT. [7]

Additionally, when the American Academy of Family Physicians was asked to comment on manual therapy; they mentioned that, while studies do support the benefits of MT; when compared to other forms of therapy, manual therapy has not been shown to be particularly superior. [86]

Therefore, based upon these bodies of research, a balanced approach towards the implementation of MT is best.

Because research seems to indicate that MT is quicker at modulating pain, potentially, MT may be considered a viable modality during the acute stages of care to aid in the pain modulation process; however, in the medium to long term, exercise programming should be considered key, as research shows that it is far more beneficial at helping individuals recover from disability. [7] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61]

6.3.2 EXERCISE THERAPY

As discussed throughout *Section 6.3.1*, Exercise Therapy involves the prescription of movement to "correct impairments, restore muscular and skeletal function, and/or [to help] maintain [an individual's] state of well-being." [12]

Research has accredited numerous benefits to the inclusion of exercise therapy within an intervention strategy; including, a reduction in symptoms related to specific pain syndromes, a restoration in bodily function; and it can also positively affect depressive disorders, improve one's resistance to illness, and also decrease the length of time of recovery. [6] [7] [8] [9] [10] [11] [12]

6.3.3 STRETCHING

Furthermore, adjunct modalities can include, Stretching for instance, also referred to as Flexibility Training; which is a form of physical exercise that is used to cause muscles to lengthen or elongate. [91]

6.3.4 SPINAL MANIPULATIONS

Spinal Manipulations, which is defined by the National Center for Complementary and Integrative Health as a series of techniques whereby practitioners use their hands or a device to apply a controlled thrust to a joint, whereby the amount of force applied varies. [89]

6.3.5 TECHNOLOGY-BASED MODALITIES

Technology-Based Modalities, which includes a range of different tools such as Electrostimulating devices, involving a Transcutaneous Electric Nerve Stimulator, commonly referred to as a TENS, which is used to modulate the contractile rhythm of muscles; or a Musculoskeletal Ultrasound device, which uses sound waves to stimulate blood flow circulation, thereby promoting healing. [92]

6.3.6 DRY NEEDLING

Other modalities still may include, Dry Needling, which involves the insertion of a thin monofilament needle without the use of an injectate. [90] This practice is typically used in the treatment of muscles, ligaments, tendons, subcutaneous fascia, scar tissue, peripheral nerves, and/or neurovascular bundles during the management of neuromusculoskeletal pain syndromes. [90]

6.3.7 FOAM ROLLING

Foam Rolling, which is defined by Healthline as a Self-Myofascial Release Technique that may potentially aid in the relieving of muscular tensions, soreness, and inflammation; thereby helping to potentially increase joint range of motion. [93]

6.3.8 OTHER MODALITIES

Or other modalities still, which can include, but isn't limited to, the use of Hot and Cold Therapy to potentially aid in the regulation of blood flow to specific area(s) of the body; which may help with inflammation processes, swelling, muscular tightness, muscle spasm, and/or arthritis pain. [92]

6.3.9 IN SUMMARY

To summarize, the goal(s) of the MSK-FP intervention process is to:
- Help modulate pain.
- Increase and/or normalize range of motion.
- Increase and/or normalize general strength levels.
- Increase and/or normalize power production.
- Increase and/or normalize endurance capacities.
- Increase and/or normalize balance capabilities.

In simpler terms, the goal(s) of intervention is to:
- Decrease and/or eliminate pain,
as much as possible.

- And restore human function, alongside musculoskeletal discrepancies uncovered during the assessment process to normal, as much as possible.

6.4 (RE)EVALUATION

While patients proceed through the intervention process, it is also imperative to re-evaluate the status of their clinical presentation(s) at frequent interval so as to validate whether baselines are changing, and whether positive progress is being obtained.

Refer back to *Chapter 4*, concerning the assessment process; and to *Chapter 5*, concerning the analysis process; as the same steps will apply during the re-evaluation process.

6.5 REVISION AND DISCHARGE

Furthermore, should the patient not progress significantly over the course of the intervention process; where minimal detectible changes are not being obtained, the clinician is left with two major options to consider:

- Either they can alter the chosen intervention strategy, in an effort to positively affect change to

the patient's clinical presentation(s).

- Or the therapist in question should refer the patient to another specialist for further investigation, and/or for possible medical care.

Once a case is brought to a close however, it becomes the clinician's role to educate the patient concerning continued support for their physical health, and to act as a guide, to said patient; concerning preventative care.

CHAPTER 7 MSK-FP : PREVENTION

This is accomplished throughout the prevention stage of The MSK-FP Method, where the goal(s) are to reduce the risk(s) of future re-injury, as much as humanly possible.

In an effort to help accomplish this goal, researchers have examined the use of exercise therapy, specifically regarding its possible applications in injury prevention; which is commonly referred to as [P]Rehabilitation, also colloquially referred to as [P]Rehab for short.

7.1 PREVENTATIVE REHABILITATION

[P]Rehab, also referred to as Preventative Rehabilitation or [P]Rehabilitation, is defined by the American College of Surgeons as a "process of improving the functional [capabilities] of [a] patient prior to [engaging in] a surgical procedure"; [102] and by The [P]rehab Guys as a method of preventative medicine whereby the goal(s) are "to reduce [the risk(s) of] injury, while [also simultaneously] improving [upon the individual's] overall physical health". [103]

While systematic reviews concerning the use of preventative rehabilitation is almost completely about its applications within the field of surgical oncology, findings are encouraging, and may translate well with regards to general population as, typically, patients show improvements in "functional [capabilities], [in their overall] maintenance of lean mass, and [in] health-related quality of life." [13]

In fact, [P]Rehab is steadily becoming a growing field in it's own rights; as, alongside a growing body of literature, the ACE Physical Therapy and Sports Medicine Institute states that, while [P]Rehabilitation cannot guarantee the prevention of injury, "developing strength, [balance and] proprioception, [as well as] endurance" may help as "performing specific [movements], activities, and exercises" may prepare the body to handle future stresses and strains. [14]

Ergo, the final stage of The Musculoskeletal Functional Performance Method of Assessment and Intervention aim(s) to address area(s) of patient empowerment, self-care, and prevention.

CHAPTER 8 CONCLUSIVE DISCUSSION

8.1 IN SUMMARY

While this dissertation is pre-clinical in nature, the telos of this study was to devise an empirical system, and identify evidence-based clinical guidelines and strategies that may help therapists; specifically Osteopathic Therapists; set objective baseline metrics, with concerns to functional presentation(s), that can subsequently be re-evaluated over the course of treatment, in an effort to validate whether or not a selected intervention strategy is truly garnering positive outcomes, in a timely manner; if at all.

From this goal, The Musculoskeletal Functional Performance Method of Assessment and Intervention was devised; which was broken down into four main stages of operation:

The **Assessment Stage** involves the use of a Postural Assessment, a Clinical Assessment, Facet Joint Irritation Testing, Orthopaedic Physical Special Testing, Active Flexibility Testing, Balance and Proprioception Testing, General Strength Testing, Power Testing, Endurance Strength Testing; and in athletic populations specifically, Predictive VO_2Max Testing.

Following the testing phase, the **Analysis Stage** involves a Pain Screening Analysis, a Musculoskeletal Functional Performance Analysis; and in athletic populations specifically, a Predictive VO_2Max Analysis.

Sequentially, following the analysis process, the **Intervention Stage** involves the selection and use of different methods of treatment, with an end goal of positively affecting baselines acquired during the assessment process; which, will ultimately help to decrease pain perception, and increase human function; as much as possible.

Lastly, once the clinical concerns have been rectified, the individual enters into the **Prevention Stage**, which will see the individual equipped with education and self-care methods and strategies, that may help to reduce risk(s) of future re-injury.

Throughout each stage of care, The MSK-FP Method can be seen as a system that empowers therapists in objectively crafting clinical impressions concerning affected structures and functional deficits; and as a system that allows therapists to objectively track how chosen intervention methods are affecting biomechanic presentation(s).

8.2 RESEARCH LIMITATIONS

That said however, while the individual components of The MSK-FP Method show scientific and clinical significance and validation; the culmination of these elements into a cohesive clinical assessment and intervention process, as outlined throughout The MSK-FP Method, has not been validated through research.

Therefore, the body of research surrounding The MSK-FP Method remains pre-clinical as a result.

8.3 FUTURE RESEARCH

Because of this, future research should aim to establish validity and reliability with concerns to The MSK-FP Method, as an empirical system of operating clinical assessments and selecting intervention strategies; sequentially aiming to establish whether the clinical guidelines and strategies presented throughout this dissertation shows scientific validity, or if they should be discredited as to having no clinical significance.

Furthermore, the significance of The MSK-FP Method itself should be subsequently compared to the traditional model of osteopathic assessment and treatment, in an effort to validate which method is truly superior in reducing pain and improving human function; if either.

8.4 FINIS HUIUS INVESTIGATIONIS

These professional evidence-based clinical guidelines and strategies; devised as a part of The MSK-FP Method, aims to draw the practice of Osteopathic Therapy into the evidence and science-based realms of care; thereby allowing for the possibility of acceptances by evidence and science-based communities; and subsequently, the possibility to integrate Osteopathy into Allied Health Care.

The Benefits and Limitations of Evidence-Based Practice in Osteopathy [94]

SCIENCE AND KNOWLEDGE ARE ALWAYS EVOLVING, AND HENCE, WE MUST ALWAYS STUDY AND UPDATE OURSELVES.

AUTHOR'S DECLARATIONS

The author has no conflict of interest to declare. There is no financial interest to report.

The MSK-FP Method outlined throughout this dissertation is amalgamated upon foundational principles, theories, and models proposed by various prominent figures of the Physical Medicine and Rehabilitation industry, this includes: King, Nelson, Dovan, Reiman, Manske, Cook, and Boyle, amongst a number of others.

Credits for all foundational principles, theories, and models belong to their respective authors, as referenced throughout this dissertation, and as referenced within the *References* section.

We certify that the submission is original work.

KEYWORDS

Osteopathy; European Osteopathy; Manual Osteopathy; Osteopathic Manual Therapy; Osteopathic Exercise Therapy; Osteopathic Manipulative Treatment; OMT; Manual Therapy; Exercise Therapy; Manual Medicine; Physical Medicine; Rehabilitation; Rehab; Prehabilitation; Prehab; Preventative Rehabilitation; Functional Performance Testing; Osteopath; Osteopathic Therapist; Osteopathic Therapy; Musculoskeletal Functional Performance Method; MSK-FP Method

REFERENCES

[1] American Association of Osteopathic Manual Practitioners. What is OMP? American Association of Osteopathic Manual Practitioners. https://www.osteopathicmanualpractice.org/what-is-omp/

[2] World Health Organization. Benchmarks for training in traditional / complementary and alternative medicine: benchmarks for training in osteopathy. World Health Organization. apps.who.int/iris/handle/10665/44356/

[3] Still, A.T. (1902). The philosophy and mechanical principles of osteopathy. American Academy of Osteopathy.

[4] Rehab-U, Mai-Linh Dovan, MSc, CAT(c). Movement Optimization for Prehab and Performance Level 1. Movement and Performance Therapy, Rehab-U.

[5] Oxford Dictionary of Sports Science & Medicine, 3 ed. Kinesiology. Oxford Dictionary of Sports Science & Medicine. https://oxfordreference.com/display/10.1093/acref/9780198568506.001.0001/acref-9780198568506-e-3805

[6] Ceballos Laita, L., Tejedor Cubillo, C., Mingo Gómez, T., & Jiménez Del Barrio, S. (2018). Effects of corrective, therapeutic exercise techniques on adolescent idiopathic scoliosis. A systematic review. Archivos argentinos de pediatria, 116(4), e582-e589. https://doi.org/10.5546/aap.2018-eng.e582

[7] Bernal-Utrera, C., Gonzalez-Gerez, J. J., Anarte-Lazo, E., & Rodriguez-Blanco, C. (2020). Manual therapy versus therapeutic exercise in non-specific chronic neck pain: a randomized controlled trail. Trials, 21(1), 682. https://doi.org/10.1186/s13063-020-04610-w

[8] Sosa-Reina, M. D., Nunez-Nagy, S., Gallego-Izquierdo, T., Pecos-Martín, D., Monserrat, J., & Álvarez-Mon, M. (2017). Effectiveness of Therapeutic Exercise in Fibromyalgia Syndrome: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. BioMed research international, 2017, 2356346. https://doi.org/10.1155/2017/2356346

[9] Carroquino-Garcia, P., Jiménez-Rejano, J. J., Medrano-Sanchez, E., de la Casa-Almeida, M., Diaz-Mohedo, E., & Suarez-Serrano, C. (2019). Therapeutic Exercise in the Treatment of Primary Dysmenorrhea: A Systematic Review and Meta-Analysis. Physical therapy, 99(10), 1371-1380. https://doi.org/10.1093/ptj/pzz101

[10] Sheikhhoseini, R., Shahrbanian, S., Sayyadi, P., & O'Sullivan, K. (2018). Effectiveness of Therapeutic Exercise on Forward Head Posture: A Systematic Review and Meta-analysis. Journal of manipulative and physiological therapeutics, 41(6), 530-539. https://doi.org/10.1016/j.jmpt.2018.02.002

[11] López-Torres Hidalgo, J., & DEP-EXERCISE Group (2019). Effectiveness of physical exercise in the treatment of depression in older adults as an alternative to antidepressant drugs in primary care. BMC psychiatry, 19(1), 21. https://doi.org/10.1186/s12888-018-1982-6

[12] Bielecki, Joseph E. and Prasanna Tadi. Therapeutic Exercise. StatPearls, StatPearls Publishing, 4 July 2022.

[13] Santa Mina D, van Rooijen SJ, Minnella EM, Alibihai SMH, Brahmbhatt P, Dalton SO, Gillis C, Grocott MPW, Howell D, Randall IM, Sabiston CM, Silver JK, Slooter G, West M, Jack S and Carli F (2021) Multiphasic Prehabilitation Across the Cancer Continuum: A Narrative Review and Conceptual Framework. Front. Oncol. 10:598425
doi: 10.3389/fonc.2020.598425

[14] ACE Physical Therapy and Sports Medicine Institute. What Is Prehabilitation? ACE Physical Therapy and Sports Medicine Institute. https://ace-pt.org/ace-physical-therapy-and-sports-medicine-institute-what-is-prehabilitation/

[15] Merriam-Webster Dictionary. Mobility.
Merriam-Webster Dictionary.
https://www.merriam-webster.com/dictionary/mobility

[16] Cambridge Dictionary. Mobility. Cambridge Dictionary.
https://dictionary.cambridge.org/dictionary/english/mobility

[17] US Davis Sports Medicine. Flexibility.
US Davis Sports Medicine.
https://health.ucdavis.edu/sports-medicine/resources/flexibility

[18] Peterka RJ. Sensorimotor integration in human postural control. J Neurophysiol 88:1097-1118, 2002.

[19] Cynthia Lions, Emmanuel Bui Quoc, Sylvette Wiener-Vacher, and Maria P. Bucci. Postural control in strabismic children: importance of proprioceptive information. Front Physiol. 2014; 5:156.

[20] Hwang S, Agada P, Kiemel T, Jeka JJ (2014) Dynamic Reweighting of Three Modalities for Sensory Fusion. PLoS ONE 9(1):e88132.
doi: 10.1371/journal.pone.0088132

[21] Diagram II - Multimodel Sensory System.
Retrieved from: Ager, A.L., Borms, D., Deschepper, L., Dhooghe, R., Dijkhuis, J., Roy, J.S., & Cools, A. Proprioception and shoulder pain: A Systematic Review. J Hand Ther. 2019 Aug 31. pii: S0894-1130(19)30094-8.
doi: 10.1016/j.jht.2019.06.002

[22] Riemann, B. L., & Lephart, S.M. (2002). The sensorimotor system, part 1: the physiological basis of functional joint stability. Journal of Athletic Training, 37(1), 71-79.

[23] Sherrington CS. On the proprio-ceptive system, especially in its reflex aspect. Brain. 1907; 29:467-482.

[24] Hung, Y. J. (2015). Neuromuscular control and rehabilitation of the unstable ankle. World Journal of Orthopedics, 6(5), page 434.

[25] Gilman, S., Joint position sense and vibration sense: anatomical organisation and assessment. Journal of neurology, neurosurgery, and psychiatry, 2002.
73(5): p. 473-7.

[26] Shakoor, N., A. Agrawal, and J.A. Block, Reduced lower extremity vibratory perception in osteoarthritis of the knee. Arthritis and rheumatism, 2008. 59(1): p. 117-21.

[27] Blanche, E.I., Bodison, S., Chang, M.C., & Reinoso, G. (2012). Development of the Comprehensive Observations of Proprioception (COP): Validity, Reliability, and Factor Analysis. Am J Occup Ther. 66(6): 691-698.
doi: 10.5014/ajot.2012.003608.

[28] Emily Cronkleton, Gregory Minnis, DPT (2019). What Is Muscular Strength, and What Are Some Exercises You Can Do? Healthline.
https://www.healthline.com/health/exercise-fitness/muscular-strength/

[29] Christian Bosse. Power Training vs Strength Training - what is the difference between Strength Training and Power Training? https://christianbosse.com/power-training-vs-strength-training-what-is-the-difference/

[30] Sapega, A. A., & Drillings, G. (1983). The definition and assessment of muscular power. The Journal of orthopaedic and sports physical therapy, 5(1), 7-9.
https://doi.org/10.2519/jospt.1983.5.1.7

[31] Cambridge Dictionary. Endurance. Cambridge Dictionary.
https://dictionary.cambridge.org/dictionary/english/endurance

[32] Merriam-Webster Dictionary. Endurance.
Merriam-Webster Dictionary.
https://www.meriam-webster.com/dictionary/endurance

[33] Diagram I - Reiman & Manske, 2009. Retrieved from: Steven King, PT, DO, Luke Nelson, DC; Movement Assessment Technologies (M.A.T.). Reiman & Manske, 2009, Principles of Functional Performance Testing.

[34] Movement Assessment Technologies (M.A.T.), Steven King, PT, DO, Luke Nelson, DC. M.A.T. Level 1.
Movement Assessment Technologies (M.A.T.).

[35] Diagram III - Cook & Boyle.
Image retrieved from: https://ultimatesandbagtraining.com/stronger-knees-through-better-exercises/.
Joint by Joint Concept Created by: Gray Cook & Mike Boyle.
https://functionalmovement.com

[36] Dr. Mennell, John M. Joint Pain. (1983).
Little Brown and Company. Dr. John M. Mennell.

[37] Hooks T. R., PT, SCS, ATC, MOMT, MTC, CSCS, FAAOMPT, Joint Mobilization, Cervical Spine Rehabilitation (2012). Physical Rehabilitation (2007).
https://www.sciencedirect.com/topics/medicine-and-dentistry/joint-mobilization

[38] Waxenbaum JA, Lu M. Physiology, Muscle Energy. [Updated 2022 Jul 25]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559029/

[39] Iqbal, M., Riaz, H., Ghous, M., & Masood, K. (2020). Comparison of Spencer muscle energy technique and Passive stretching in adhesive capsulitis: A single blind randomized control trial. JPMA. The Journal of the Pakistan Medical Association, 70(12(A)), 2113-2118. https://doi.org/10.5455/JPMA.23971

[40] Thomas, E., Cavallaro, A. R., Mani, D., Bianco, A., & Palma, A. (2019). The efficacy of muscle energy techniques in symptomatic and asymptomatic subjects: a systematic review. Chiropractic & manual therapies, 27, 35. https://doi.org/10.1186/s12998-019-0258-7

[41] Osama, M., & Shakil Ur Rehman, S. (2020). Effects of static stretching as compared to autogenic inhibition and reciprocal inhibition muscle energy techniques in the management of mechanical neck pain: a randomized controlled trial. JPMA. The Journal of the Pakistan Medical Association, 70(5), 786-790. https://doi.org/10.5455/JPMA.9596

[42] Sadria, G., Hosseini, M., Rezasoltani, A., Akbarzadeh Bagheban, A., Davari, A., & Seifolahi, A. (2017). A comparison of the effect of the active release and muscle energy techniques on the latent trigger points of the upper trapezius. Journal of bodywork and movement therapies, 21(4), 920-925. https://doi.org/10.1016/j.jbmt.2016.10.005

[43] Razzaq, A., Nadeem, R. D., Akhtar, M., Ghazanfar, M., Aslam, N., & Nawaz, S. (2022). Comparing the effects of muscle energy technique and mulligan mobilization with movements on pain, range of motion, and disability in adhesive capsulitis. JPMA. The Journal of Pakistan Medical Association, 72(1), 13-16. https://doi.org/10.47391/JPMA.1360

[44] Joint Mobilization and Manipulation. Gale Encyclopedia of Nursing and Allied Health. Retrieved November 29, 2022 from Encyclopedia.com: https://www.encyclopedia.com/medicine/encyclopedias-almanacs-transcripts-and-maps/joint-mobilization-and-manipulation

[45] Hindle, K. B., Whitcomb, T. J., Briggs, W. O., & Hong, J. (2012). Proprioceptive Neuromuscular Facilitation (PNF): Its Mechanisms and Effects on Range of Motion and Muscular Function. Journal of human kinetics, 31, 105-113. https://doi.org/10.2478/v10078-012-0011-y

[46] Massage therapy: What you need to know. National Center for Complementary and Integrative Health. Accessed December 12 2022: https://www.nccih.nih.gov/health/massage-therapy-what-you-need-to-know

[47] Ali, A., Rosenberger, L., Weiss, T. R., Milak, C., & Perlman, A. I. (2017). Massage Therapy and Quality of Life in Osteoarthritis of the Knee: A Qualitative Study. Pain medicine (Malden, Mass.), 18(6), 1168-1175. https://doi.org/10.1093/pm/pnw217

[48] Li, Y. H., Wang, F. Y., Feng, C. Q., Yang, X. F., & Sun, Y. H. (2014). Massage therapy for fibromyalgia: a systematic review and meta-analysis of randomized controlled trials. PloS one, 9(2), e89304. https://doi.org/10.1371/journal.pone.0089304

[49] Schiowitz S. (1990). Facilitated positional release. The Journal of the American Osteopathic Association, 90(2), 145-155. https://pubmed.ncbi.nlm.nih.gov/2407698/

[50] Mohamadi, M., Rojhani-Shirazi, Z., Assadsangabi, R., & Rahimi-Jaberi, A. (2020). Can the Positional Release Technique Affect Central Sensitization in Patients With Chronic Tension-Type Headache? A Randomized Clinical Trial. Archives of physical medicine and rehabilitation, 101(10), 1696-1703. https://doi.org/10.1016/j.apmr.2020.05.028

[51] Bethers, A. H., Swanson, D. C., Sponbeck, J. K., Mitchell, U. H., Draper, D. O., Feland, J. B., & Johnson, A. W. (2021). Positional release therapy and therapeutic massage reduce muscle trigger and tender points. Journal of bodywork and movement therapies, 28, 264-270. https://doi.org/10.1016/j.jbmt.2021.07.005

[52] Danazumi, M. S., Yakasai, A. M., Ibrahim, A. A., Shehu, U. T., & Ibrahim, S. U. (2021). Effect of integrated neuromuscular inhibition technique compared with positional release technique in the management of piriformis syndrome. Journal of osteopathic medicine, 121(8), 693-703. https://doi.org/10.1515/jom-2020-0327

[53] Saleem, R., Bashir, M. S., & Noor, R. (2022). Effects of sequential approach of positional release for subscapularis and OLA Grimsby technique on shoulder external rotation in adhesive. JPMA. The Journal of the Pakistan Medical Association, 72(9), 1831-1833, https://doi.org/10.47391/JPMA.0447

[54] Mohammadi Kojidi, M., Okhovatian, F., Rahimi, A., Baghban, A. A., & Azimi, H. (2016). The influence of Positional Release Therapy on the myofascial trigger points of the upper trapezius muscle in computer users. Journal of bodywork and movement therapies, 20(4), 767-773. https://doi.org/10.1016/j.jbmt.2016.04.006

[55] Barnes, P., & Rivera, M. (2022). The Effect of Active Release Technique® on Clinician and Patient-Reported Outcomes: A Systematic Review. Journal of sport rehabilitation, 31(3), 331-336. https://doi.org/10.1123/jsr.2021-0106

[56] Ghanbari, A., Rahimijaberi, A., Mohamadi, M., Abbasi, L., & Sarvestani, F. K. (2012). The effect of trigger point management by positional release therapy on tension type headache. NeuroRehabilitation, 30(4), 333-339. https://doi.org/10.3233/NRE-2012-0764

[57] Ceballos Laita, L., Tejedor Cubillo, C., Mingo Gómez, T., & Jiménez Del Barrio, S. (2018). Effects of corrective, therapeutic exercise techniques on adolescent idiopathic scoliosis. A systematic review. Archivos argentinos de pediatria, 116(4), e582-e589. https://doi.org/10.5546/aap.2018-eng.e582

[58] Bernal-Utrera, C., Gonzalez-Gerez, J. J., Anarte-Lazo, E., & Rodriguez-Blanco, C. (2020). Manual therapy versus therapeutic exercise in non-specific chronic neck pain: a randomized controlled trial. Trials, 21(1), 682. https://doi.org/10.1186/s13063-020-04610-w

[59] Sosa-Reina, M. D., Nunez-Nagy, S., Gallego-Izquierdo, T., Pecos-Martín, D., Monserrat, J., & Álvarez-Mon, M. (2017). Effectiveness of Therapeutic Exercise in Fibromyalgia Syndrome: A Systematic Review and Meta-Analysis of Randomized Clinical Trials. BioMed research international, 2017, 2356346. https://doi.org/10.1155/2017/2356346

[60] Carroquino-Garcia, P., Jiménez-Rejano, J. J., Medrano-Sanchez, E., de la Casa-Almeida, M., Diaz-Mohedo, E., & Suarez-Serrano, C. (2019). Therapeutic Exercise in the Treatment of Primary Dysmenorrhea: A Systematic Review and Meta-Analysis. Physical therapy, 99(10), 1371-1380. https://doi.org/10.1093/ptj/pzz101

[61] Sheikhhoseini, R., Shahrbanian, S., Sayyadi, P., & O'Sullivan, K. (2018). Effectiveness of Therapeutic Exercise on Forward Head Posture: A Systematic Review and Meta-analysis. Journal of manipulative and physiological therapeutics, 41(6), 530-539. https://doi.org/10.1016/j.jmpt.2018.02.002

[62] López-Torres Hidalgo, J., & DEP-EXERCISE Group (2019). Effectiveness of physical exercise in the treatment of depression in older adults as an alternative to antidepressant drugs in primary care. BMC psychiatry, 19(1), 21. https://doi.org/10.1186/s12888-018-1982-6

[63] Bielecki, Joseph E. and Prasanna Tadi. Therapeutic Exercise. StatPearls, StatPearls Publishing, 4 July 2022.

[64] Miake-Lye, I. M., Mak, S., Lee, J., Luger, T., Taylor, S. L., Shanman, R., Beroes-Severin, J. M., & Shekelle, P. G. (2019). Massage for Pain: An Evidence Map. Journal of alternative and complementary medicine (New York, N.Y.), 25(5), 475-502. https://doi.org/10.1089/acm.2018.0282

[65] Nelson, N. L., & Churilla, J. R. (2017). Massage Therapy for Pain and Function in Patients With Arthritis: A Systematic Review of Randomized Controlled Trials. American journal of physical medicine & rehabilitation, 96(9), 665-672. https://doi.org/10.1097/PHM.0000000000000071

[66] Furlan, A. D., Giraldo, M., Baskwill, A., Irvin, E., & Imamura, M. (2015). Massage for low-back pain. The Cochrane database of systematic reviews, 2015(9), CD001929. https://doi.org/10.1002/14651858.CD001929.pub3

[67] Poppendieck, W., Wegmann, M., Ferrauti, A., Kellmann, M., Pfeiffer, M., & Meyer, T. (2016). Massage and Performance Recovery: A Meta-Analytical Review. Sports medicine (Auckland, N.Z.), 46(2), 183-204. https://doi.org/10.1007/s40279-015-0420-x

[68] Zavala-González, J., Pavez-Baeza, F., Gutiérrez-Espinoza, H., & Olguín-Huerta, C. (2018). The effectiveness of joint mobilization techniques for range of motion in adult patients with primary adhesive capsulitis of the shoulder: a systematic review and meta-analysis. 18(5), e7265. https://doi.org/10.5867/medwave.2018.05.7265

[69] Rahbar, M., Ranjbar Kiyakalayeh, S., Mirzajani, R., Eftekharsadat, B., & Dolatkhah, N. (2022). Effectiveness of acromioclavicular joint mobilization and physical therapy vs physical therapy alone in patients with frozen shoulder: A randomized clinical trial. Clinical rehabilitation, 36(5), 669-682. https://doi.org/10.1177/02692155211070451

[70] Noten, Suzie et al. Efficacy of Different Types of Mobilization Techniques in Patients with Primary Adhesive Capsulitis of the Shoulder: A Systematic Review. Archives of physical medicine and rehabilitation vol. 97, 5 (2016): 815-25. https://doi:10.1016/j.apmr.2015.07.025

[71] Victoria Espí-López, Gemma et al. Effectiveness of Physical Therapy in Patients with Tension-type Headache: Literature Review. Journal of the Japanese Physical Therapy Association = Rigaku ryoho vol. 17, 1 (2014): 31-38. doi: 10.1298/jjpta.Vol17_005

[72] Cho, J., Lee, E., & Lee, S. (2019). Upper cervical and upper thoracic spine mobilization versus deep cervical flexors exercise in individuals with forward head posture: A randomized clinical trial investigating their effectiveness. Journal of back and musculoskeletal rehabilitation, 32(4), 595-602. https://doi.org/10.3233/BMR-181228

[73] Ulger, Ozlem et al. The effect of manual therapy and exercise in patients with chronic low back pain: Double blind randomized controlled trial. Journal of back and musculoskeletal rehabilitation vol. 30,6 (2017): 1303-1309. doi:10.3233/BMR-169673

[74] Cho, K. H., & Park, S. J. (2020). Effects of joint mobilization and stretching on the range of motion for ankle joint and spatiotemporal gait variables in stroke patients. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association, 29(8), 104933. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.104933

[75] Kuligowski, T., Skrzek, A., Cieślik, B. (2021). Manual Therapy in Cervical and Lumbar Radiculopathy: A Systemic Review of the Literature. International journal of environmental research and public health, 18(11), 6176. https://doi.org/10.3390/ijerph18116176

[76] Armijo-Olivo, S., Pitance, L., Singh, V., Neto, F., Thie, N., & Michelotti, A. (2016). Effectiveness of Manual Therapy and Therapeutic Exercise for Temporomandibular Disorders: Systematic Review and Meta-Analysis. Physical therapy, 96(1), 9-25. https://doi.org/10.2522/ptj.20140548

[77] Weerasekara, I., Osmotherly, P., Snodgrass, S., Marquez, J., de Zoete, R., & Rivett, D. A. (2018). Clinical Benefits of Joint Mobilization on Ankle Sprains: A Systemic Review and Meta-Analysis. Archives of physical medicine and rehabilitation, 99(7), 1395-1412.e5. https://doi.org/10.1016/j.apmr.2017.07.019

[78] Physical Examination Techniques: A Nurse's Guide by Jennifer Lapum; Michelle Hughes; Oona St-Amant; Wendy Garcia; Margaret Verkuyl; Paul Petrie; Frances Dimaranan; Mahidhar Pemasani; and Nada Savicevic is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License, except where otherwise noted.
https://pressbooks.library.torontomu.ca/ippa/chapter/chapter-1/

[79] Rehab-U, Mai-Linh Dovan, MSc, CAT(c). Mobility Fundamentals for Prehab and Performance.
Movement and Performance Therapy, Rehab-U.

[80] Diagram IV - Dovan, Mob. Fundamentals. Retrieved from: Rehab-U, Mai Linh Dovan, MSc, CAT(c). Movement and Performance Therapy, Rehab-U.

[81] Michael A. Seffinger, DO, FAAFP, Raymond J. Hruby, DO, FAAO, MS. (2007). Chapter 3 - Manual Diagnostic Procedures Overview. Evidence-Based Manual Medicine - A Problem-Oriented Approach. Pages 35-58.
https://doi.org/10.1016/B978-1-4160-2384-5.50007-9

[82] José Luís Pimentel do Rosário, PhD. (2014). Biomechanical assessment of human posture: A literature review. Journal of Bodywork and Movement Therapies. Vol. 18, Issue 3. Pages 368-373.
https://doi.org/10.1016/j.jbmt.2013.11.018

[83] Courtney, R. (2009). The function of breathing and its dysfunctions and their relationship to breathing therapy. International Journal of Osteopathic Medicine 12:78-85.
https://doi.org/10.1016/j.ijosm.2009.04.002

[84] MedlinePlus Medical Dictionary. Palpation.
MedlinePlus Medical Dictionary.
https://medlineplus.gov/ency/article/002284.htm

[85] Pan American Health Organization. Risk Assessment.
Pan American Health Organization.
https://www.paho.org/en/detection-verification-and-risk-assessment-dva/risk-assessment

[86] Law Insider. Clinical Impression Definition. Law Insider.
https://www.lawinsider.com/dictionary/clinical-impression

[87] Diagram V - Modalities Defined By M.A.T.
Retrieved from: Steven King, PT, DO, Luke Nelson, DC; Movement Assessment Technologies (M.A.T.), Level 1 Course.

[88] Snyder MJ, Hawks MK, Moss DA, Crawford PF 3rd. Integrative Medicine: Manual Therapy. FP Essent. 2021 Jun; 505:11-17. PMID: 34128626.
https://pubmed.ncbi.nlm.nih.gov/34128626

[89] Collins Dictionary. Medical Intervention Definition. Collins Dictionary.
https://www.collinsdictionary.com/dictionary/english/medical-intervention

[90] Sheldon A, Karas S. Journal of Bodywork and Movement Therapies, Vol. 31, July 2022, Pgs 159-163. Adverse events associated with manual therapy of peripheral joints: A scoping review.
https://doi.org/10.1016/j.jbmt.2022.04.012

[91] National Center for Complementary and Integrative Health, NIH. Spinal Manipulation: What You Need To Know. National Center for Complementary and Integrative Health.
https://www.nccih.nih.gov/health/spinal-manipulation-what-you-need-to-know

[92] Dunning J, Butts R, Mourad F, Young I, Flannagan S, Perreault T. Dry needling: a literature review with implications for clinical practice guidelines. Phys Ther Rev. 2014 Aug; 19(4): 252-265. doi: 10.1179/108331913X13844245102034.
PMID: 25143704; PMCID: PMC4117383.

[93] Physiopedia. Stretching. Physiopedia.
https://www.physio-pedia.com/Stretching

[94] Medical Rehabilitation Centers of Pennsylvania for Physical Medicine, MRCP. (Oct 2021). What Are Modalities and How Are they Used in Physical Therapy? Medical Rehabilitation Centers of Pennsylvania for Physical Medicine.
https://www.medicalrehabilitationcenterspa.com/what-are-modalities-and-how-are-they-used-in-physical-therapy/

[95] Healthline. What Are the Benefits of Foam Rolling? (Apr 2019). Jane Chertoff. Medically reviewed by: Daniel Bubnis, M.S., NASM-CPT, NASE Level-II-CSS. Healthline.
https://www.healthline.com/health/foam-roller-benefits

[96] Bordoni B. (2019). The Benefits and Limitations of Evidence-based Practice in Osteopathy. Cureus, 11(11), e6093.
https://doi.org/10.7759/cureus.6093

[97] Rehab-U, Mai-Linh Dovan, MSc, CAT(c). Movement Optimization for Prehab and Performance Level 2.
Movement and Performance Therapy, Rehab-U.

[98] Allied Health Professions Australia. What is Allied Health? Allied Health Professions Australia.
https://ahpa.com.au/what-is-allied-health/

[99] National University of Medical Sciences, Spain. Clinical Ergonomics, Lecture #9: Ergonomics: Low Back Pain cont.
National University of Medical Sciences, Spain.

[100] Franke H, Franke JD, Fryer G (August 2014). Osteopathic manipulative treatment for nonspecific low back pain: a systematic review and meta-analysis. BMC Musculoskeletal Disorders (Systematic review & meta-analysis). 15(1): 286.
doi:10.1186/1471-2474-15-286. PMID: 25175885.

[101] Hondras, Maria A.; Linde, Klaus; Jones, Arthur P. (2005). Hondras, Maria A. (ed.). Manual therapy for asthma. Cochrane Database of Systematic Reviews (2): CD001002.
doi:10.1002/14651858.CD001002.pub2. PMID: 15846609.

[102] Chen, Xiaomei; Jiang, Jiaojiao; Wang, Renjie; Fu, Hongbo; Lu, Jing; Yang, Ming (6 September 2022). Chest physiotherapy for pneumonia in adults. The Cochrane Database of Systematic Reviews. 2022(9): CD006338. doi:10.1002/14651858.CD006338.pub4. PMID: 36066373.

[103] Guillaud, Albin; Darbois, Nelly; Monvoisin, Richard; Pinsault, Nicolas (2018). Reliability of diagnosis and clinical efficacy of visceral osteopathy: a systematic review. BMC Complementary and Alternative Medicine. 18(2):65. doi:10.1186/s12906-018-2098-8. PMID: 29452579.

[104] American College of Surgeons. Prehabilitation. American College of Surgeons. https://www.facs.org/for-patients/strong-for-surgery/prehabilitation/

[105] C. Lindell, PT, DPT, CSCS. The [P]rehab Guys. What is Prehab? The [P]rehab Guys. https://theprehabguys.com/what-is-prehab-2/

[106] National Research Council (US) and Institute of Medicine (US) Panel on Musculoskeletal Disorders and the Workplace. Musculoskeletal Disorders and the Workplace: Low Back and Upper Extremities. Washington (DC): National Academies Press (US); 2001. 6, Biomechanics. Available from: https://www.ncbi.nlm.nih.gov/books/NBK222434/

[107] Sueki DG, Cleland JA, Wainner RS. A regional interdependence model of musculoskeletal dysfunction: research, mechanisms, and clinical implications. J Man Manip Ther. 2013 May; 21(2): 90-102. doi: 10.1179/2042618612Y.0000000027. PMID: 24421619; PMCID: PMC3649356.

[108] Statistics Canada. Table 2 Modified Canadian Aerobic Fitness Test (VO_{2Max}) percentile values by age group and sex. Canadian Health Measures Survey cycle 5 (2016 to 2017). Statistics Canada. www150.statcan.gc.ca/n1/pub/82-003-x/2019010/article/00002/tbl/tbl02-eng.htm