National University of Medical Sciences

THESIS

EFFECT OF MANUAL THERAPY ON PATIENT WITH OSTEO-DISCOGENIC SPINAL STENOSIS

By

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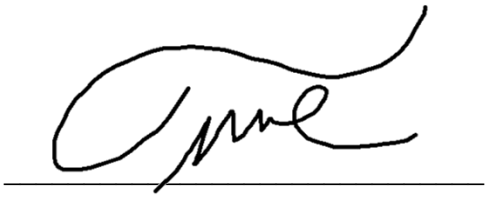
DECLARATION

I declare that the work in this thesis titled "**The Effect of Manual Therapy on Patients with Osteo-discogenic Spinal Stenosis**" has been carried out by me. The information derived from articles, literature, books, etc. has been duly acknowledged in the test, and a list of references was provided. No part of this thesis was previously presented for another degree or diploma at this or any other institution.



Victor Henry

29 May 2023

Date

DEDICATION

I dedicate this thesis work to my family and friends. A special feeling of gratitude to my dear parents; although they are no longer in this world, their memories continue to regulate my life. Their words of encouragement and push for tenacity resonate in my ears. Thank you for watching closely during my educational journey. Special thanks to my many patients who have supported me throughout the entire process. I will always appreciate your trust in my clinical expertise.

Last but not least, to Almighty God, my strong pillar, source of inspiration, wisdom, knowledge, and understanding. He has been the source of my strength throughout this program and only on his wings have I risen.

I LOVE YOU ALL!

ABSTRACT

One of the most popular therapeutic approaches for the management of pain and musculoskeletal disorders is manual therapy. Its development started several centuries ago and culminated in the current standard practices in the fields of physiotherapy, osteopathy, and chiropractic care today, which primarily focus on the treatment of joints and myofascial tissues. The role of manual therapy and the healthcare professionals who specialize in manipulative therapy within the biopsychosocial model, which focuses on the patient and their functionality, has been re-evaluated thanks to advances in our understanding of the mechanisms underlying this therapy's effectiveness as well as the mediators of the medium- and long-term effectiveness of musculoskeletal rehabilitation processes.

Aiming to make positive changes in at least one aspect of the patient's pain experience, the use of manual therapy as a passive skilled movement applied by clinicians, directly or indirectly helps treat a variety of anatomical structure dysfunctions. The foundation of manual therapy is clinical reasoning, which aims to improve patient management of musculoskeletal pain by influencing variables from a multidimensional perspective that may have a positive effect on clinical outcomes. Additional knowledge about the procedure and potential mechanisms by which manual therapy may work is provided by the influence of biomechanical, neurophysiological, psychological, and general patient factors as treatment mediators and/or moderators. We must advance our understanding of the underlying mechanisms underlying manual therapy as healthcare delivery moves toward personalized methods. This doctoral thesis will be focused on manual therapy treatment for cervical and lumbar spine and joint manipulation or mobilization.

Keywords: Disc degenerative disease, Cervical spine stenosis, Discovertebral complex, Cervical and low back pain, Intervertebral disc, Cervical pain, Internal endplate disruption, Disc degeneration classification, Manual therapy and spine, Spine manipulation, Muscles in the spine region, Alternative spine treatment, Manual therapy pioneers.

ABBREVIATION

ADL: Activity of daily living

CT: Computed Tomography

CNS: Central Nervous System

DN: Dry Needling

EMG: Electromyography

GCC: General Chiropractic council

HVLA: High Velocity Low Amplitude

HVLAT: High Velocity Low Amplitude Thrust

IMT: Integrated Manual Therapy

IASTM: Instrument Assisted Soft Tissue Massage

MRI: Magnetic Resonance Imaging

MET: Muscle Energy Technique

MT: Manual Therapy

MD: Medical Doctor

MWM: Mobilization with Movement

NMR: Nuclear Magnetic Resonance

NSAID: Nonsteroidal Anti-inflammatory Drug

NAGS: Natural Apophyseal Glide

PNF: Proprioceptive Electrical Facilitation

QL: Quadratus Lumbarum

ROM: Range Of Motion

SNAG: Sustained Natural Apophyseal Glide

TRP: Trigger Point Therapy

TMJ: Temporal Mandibular Joint

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CHAPTER I

Introduction

Manual therapy is a non-surgical form of conservative management that entails several skilled hands-on techniques applied to the patient's body (spine and extremities) to evaluate, diagnose, and treat a variety of symptoms and diseases (Hoving J. L. et al., 2002, Garofalo J.P., Polatin P., 1999, McKenzie R. A, and May S., 2003). There are many distinct manual treatment techniques, which can be divided into four main categories: manipulation (thrust manipulation), mobilization (non-thrust manipulation), static stretching, and muscular energy approaches. Different medical practitioners have different ideas about what manual therapy is and what it is supposed to accomplish.

The word "manual therapy" refers to a broad range of procedures, including stretching, massage, joint mobilization, Active Release Technique, Strain-Counterstrain, Myofascial Release, and others. Even while a large range of manual therapy techniques are widely employed, there is still only a limited amount of evidence to support them. Professionals including massage therapists, athletic trainers, and physical therapists frequently use manual therapy techniques as a supplemental part of the healing process.

Osteo-discogenic and spinal stenosis have become major players in disability. The deteriorating disease is often treated with spinal manipulation and mobilization. Back pain is a significant health issue that has negative societal and economic effects on industrialized nations. According to estimates, 85% of Americans will suffer from back problems at some point in their lives (Mulligan B. R., 2010). Over the past few decades, research data has shown that 90% of the population will suffer from low back pain in their lifetime. The spine plays a very important role due to its support and structure in the human body. It can facilitate movements, as well as the protection of the spinal cord, nerves, and surrounding organs. The discs found in each vertebrate function as a shock absorber. With age, these discs often

degenerate resulting in the vertebrate coming closer together in which disc degeneration is among the leading causes of pain manifested through multiple pathways.

On the other hand, Stenosis of the spine is known as a condition where a narrowing of the neural foramen or central canal reduces in diameter, and compression of the nerve occurs. It is a condition that interferes with daily life activities (ADL) and in some cases it can be debilitating.

The majority of individuals who are considered leaders in manipulative treatments currently use manual techniques and clinical practices that are largely based on biomechanical presumptions that the patient's symptoms are caused by palpatory discernible dysfunctions that can be treated with targeted techniques for joint tissue (McKenzie and May 2003; Mulligan, 2010; Ernst, 2008), myofascial tissue (Travell and Simons, 1998; Jones, 2004; Stecco and Day, 2010), or nervous tissue (Upledger 1995).

All of these ideas, which are based on anatomical theoretical models of musculoskeletal and health disorders, were developed as a result of the frequently brilliant intuitions of various authors, but they must be understood in the context of the knowledge, cultural contexts, technological advancements, and instrumentation available at the time in which they were developed (Smith, 2007).

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CHAPTER II

General Spine Anatomy

The spine column is made up of 32 or 34 bones (depending on the individual. It acts as a nervous and structural support for the body, allowing the body to forward flexion, back extension, lateral flexion, and rotation. It protects the nerve as it travels from the brain to the toes and other areas in the body.

The composition of the spine is of 24 bones (in adulthood) called vertebrae in addition to 2 other sections called sacrum and coccyx. Generally, when speaking about the vertebrae column this refers to the 24 bones of the spine “C1 - T12 - L5”.

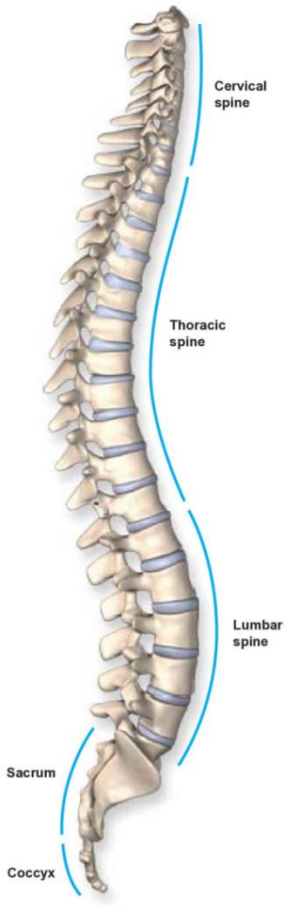

Figure 1: Spine structure. Orthoriverside

When viewed from the side, the spine has the shape of an S. These curvatures are cervical lordosis (for the cervical segment), thoracic kyphosis (for the thoracic spine segment), and lumbar lordosis (for the lumbar spine segment). The made up of spine provides great shock absorption qualities. (Modes et al. 2022).

Cervical Spine	C1 – C7 C1 = Atlas - C2 = Axis
Thoracic Spine	Th1–Th12
Lumbar Spine	L1–L5
Sacrum	S1–S5 (fused vertebrae)
Coccyx	Cx1–Cx4 (commonly), Cx1–Cx5 (all used)

Table 1: Vertebrae column's division

Cervical

The cervical spine, as mentioned earlier *(table 1)*, has 7 bones called vertebrae known as C1 through C7. The most superior vertebrae connect the skull to the spine (craniocervical junction, C1 – C2), while the lower segments (subaxial spine, C3 – C7) connect to the upper back. As a structure made up of bones, muscles, nerves, tendons, ligaments and delicate, the cervical spine hosts the spinal cord from where all messages from the brain are sent to control the body. The cervical segment of the spine is strong and flexible, supports the weight of the cranium, and permits the head and neck to execute all directional movements. (Bland, Boushey, 1990)

C1 and C2 are responsible to provide support and host the base of the occiput at the atlanto occipital articulation. C1 (Atlas) has the shape form of a ring to accommodate the spinal cord due to exiting through the foramen magnum. Another feature of the atlas is a pronounced concave to accommodate the convex occipital condyle therefore allowing the neck to do flexion and extension but limited side flexions. (Hsu, 2011), (Bogduk, 2000). The other 5 vertebrae, C3-C7, have similar morphological and functional features as C1-C2 sharing similarities with typical vertebrae anatomy. (Bland, Boushey, 1990).

The cervical intervertebral discs provide three important things to the spine: motion, weight transfer, and stability. Four parts form the intervertebral discs:

- Central nucleus pulposus
- Annulus fibrosus
- 2 end plates

the physiological lordosis of the cervical spine is formed due to the thickness of the anterior portion of the intervertebral discs. (Guo et al., 2018).

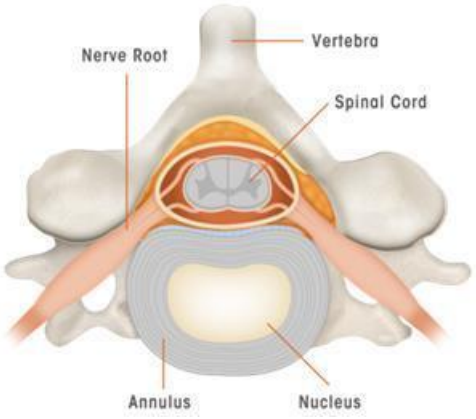

Figure 2: Cervical spine. Camber's spine

Thoracic

The thoracic region is composed of 12 vertebrae spanning from Th 1-Th 12 and 12 intervertebral discs. These vertebrae together form a kyphotic curve, and additional provide attachments to the ribs. Spinal nerves exit the spine through the space created by the interconnection of the laminae, pedicles, and surrounding vertebrae's articular processes. (DaSai et al., 2022), (Mrozkowiak et al. 2018), (Movahed et al., 2017). The rigidity of the thoracic spine is due to the rib cage which in turn protects vital organs in the body therefore incurring limited motion. (Evans, Ronald C, 2009). Its main functions bearing heavy load, protection of the spinal cord, as well as maintaining posture and stability in the trunk. (Edmondston, Singer, 1997)

The vertebrae of the thoracic spine differ in size width, depth, and thickness increasing in a descending manner from Th1-Th12 due to the load bearing from preceding vertebrae. Th11

and Th12 have no ribs connected to them, however, Th12 has similar characteristics to the thoracic vertebrae in its superior segment, and similar characteristics to the lumbar vertebrae in its inferior segment to articulate with L1 therefore allowing its movements on Th11 and preventing movement on L1. (Goh et al., 2000). Bundles of nerves (afferent and efferent nerves) originating at the spinal cord, make their way through the thoracic spine to innervate the thoracic surrounding muscles such as the pectoralis, latissimus dorsi, rectus abdominis, and the intercostal muscles.

The intercostal muscles are innervated by the sympathetic nerve system which originates at the thoracic spine up to the top of L1 and L2, these nerves help regulate involuntary functions such as regulating blood pressure, heart rate, bladder, liver, body temperature, etc (Cervero and Tattersall, 1986). Because from where these involuntary nerve groups originate (thoracic spine and sacrum) serious damage to the nerve can occur if the nerves are impinged. This nerve travels in proximity to the vertebral discs, therefore a correct posture is eminent. Damage to the intervertebral discs is less prevalent due to the support the ribcage provides. (Son et al., 2012).

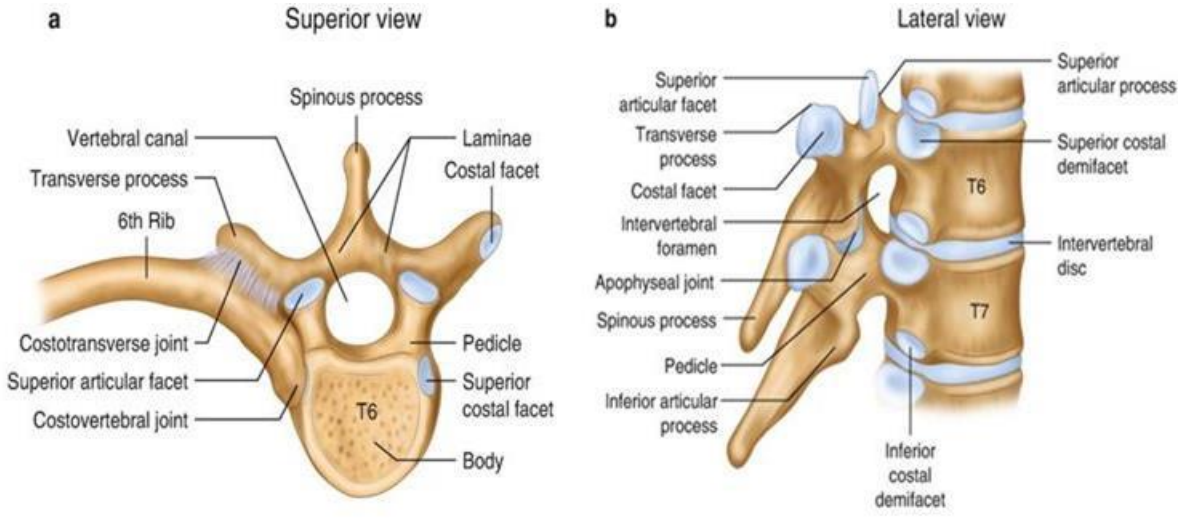

Figure 3: Anatomical consideration of thoracic spine. Springer

Lumbar

The third segment of the spine is the lumbar made up of five vertebrae from L1 – L5 plus 5 intervertebral discs. Its main function is to bear the load and provide protection to the spinal

cord during movements such as flexion, extension, side bending, and rotation, and provide stability to the trunk while in motion. (Boszczyk et al., 2001).

The resiliency of the lumbar spine is of utmost important due to not only carrying the weight of the upper segment of the body, but it must maintain stability and mobility during various conditions. Besides all the demands of stability, mobility, and weight transfer, the lumber spine's normal ROM is 23.9° to 60° flexion, 25° extension, and 25° side bending.(Ecola et al., 1996), and it should manage the ability to perform rotation for up to 7° - 7.5°. (Houghston et al., 2002).

The lumbar vertebrae are different in size than the other vertebrae in the spine, this is because, besides the demand the lumbar spine has in maintaining posture, plus the weight and amount of torsion movements it undergoes including lifting, bending, and jumping. (Granhed et al., 1987) , Tan et. Al., 2004).

Figure 4: Lumbar spine. Rapid Physio Care

Afferent and efferent nerves of the lumbar spine branching from different levels, when disturbed, might have an impact on a patient's activities of daily living. (Luma et al., 2000), (Shah et al., 1978). These nerves are responsible for the control of the lower extremities and once injured any or all of these symptoms such as leg extension, weakness, loss of feeling, tingling, and lower back pain. (Nygaard and Mellgren, 1998).

Sacrum

We find below the lumbar a collection of five fused vertebrae (S1 – S5) called sacrum. (Agur and Dalley, 2009). The sacrum serves as the connector to the spine because of its resting

position in correlation to the hip bone. (Bogduck, 20120. The explanation provided by Agur, 2009 on the formation of the sacrum is very important. The sacrum fusion it's not present in adolescents until the age of 23.

In the sacrum, the afferent and efferent nerves originate at the spinal cord and travel through L5/S1 space which correlates to one of the most common injuries - the sciatic nerve presenting symptoms of pain and numbness. (Koes et al., 2007)

Coccyal

The coccyx is a segment of the lower extremities skeletal system formed of five fused bones commonly known as the "tail bone" and the number of these bones varies in individuals, the norm is four fused bones in an individual. (Agur & Dalley, 2009). The coccyal bone houses ligaments, muscles, and pelvic tendons, and acts as the body stabilizer in a sitting position. (Lirette et. Al., 2014).

Afferent and efferent nerves and intervertebral discs are not elements of the composition of the coccyal bone.

The Spine Intervertebral Discs

The intervertebral discs are found along the spine, and makeup about 20 – 30% of the spine length with the unique function of managing the demanding stress (individual vertebrae movement, assisting to deliver nutrients to the spine and spinal cord, loading cushioning, distribution of weight, shock absorber), imposed on them. (Humzah et al., 1988).

The annulus fibrosus, nucleus pulposus, and vertebral endplates are the components of the intervertebral discs. The intervertebral disc structure and mechanical functionality depend on the combined work of the three components (Raj, 2008), a low level of vascularization due to a lack of vessels in the internal segment of the discs. The small portion of nutrients travel to the intervertebral discs through a diffusion that takes place in the pre-disk vessels reaching the outside layer of the disk.

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CHAPTER III

Osteo-Discogenic

Osteo Discogenic of the cervical and lumber spine segments has been defined as the wear and tear of intervertebral discs that act as a cushion for the spine. Many researchers have approached discogenic from many angles attributing the results to diverse ideas and reasoning making it difficult to establish the process and relation to growth, aging, adaptation, and healing process. As far as researchers agree one of the processes of life is aging and with this process a wear and tear of many parts in the human body takes precedence; this includes the degenerative process of the spine. This process also occurs in the knee and the hip.

Etiology

It is unknown the reasons why the spinal joints wear out, however, this process could be in connection with the type of physical activity a person undergoes throughout life, a family member's medical history especially with problems of the spine, maybe spinal injury-related conditions, etc. During a physical examination, sometimes routine imaging of the spine is requested, and often degenerative disease of the spine is commonly found. This can be correlated to physiological aging, as mentioned before, to some pathological conditions, and often it is unclear to determine the deference between each other.

Mostly common in the cervical spine and lower back, degenerative disc disorder or structure of the human body causes a distinctive group of symptoms, signs, and anatomical changes, and it affects both sexes from early ages and is prevalent around age 40. It has been considered that a standing position might be a major contributor to the prevalence of degenerative discs of the cervical and lower back spine, especially making the lumbar spine more prone to degenerative conditions. The condition is a common event that involves the entire unit of a functional spine, causing two segments of the spine - the body of a vertebrate and the intervertebral disc to be affected. With the aging process, the disc and zygapophyseal joints experienced constant micro and macro trauma creating changes in biomechanical forces on the spine.

Discogenic – degenerative disc it's not a disease as it is considered to be. We need to see it as a condition in which age-related wear and tear takes precedence on a disc resulting in pain, instability, and other symptoms. Disc degeneration will continue its course over time; however, the pain as a result of the degenerative disc doesn't worsen.

Normal disc **Degenerate disc**

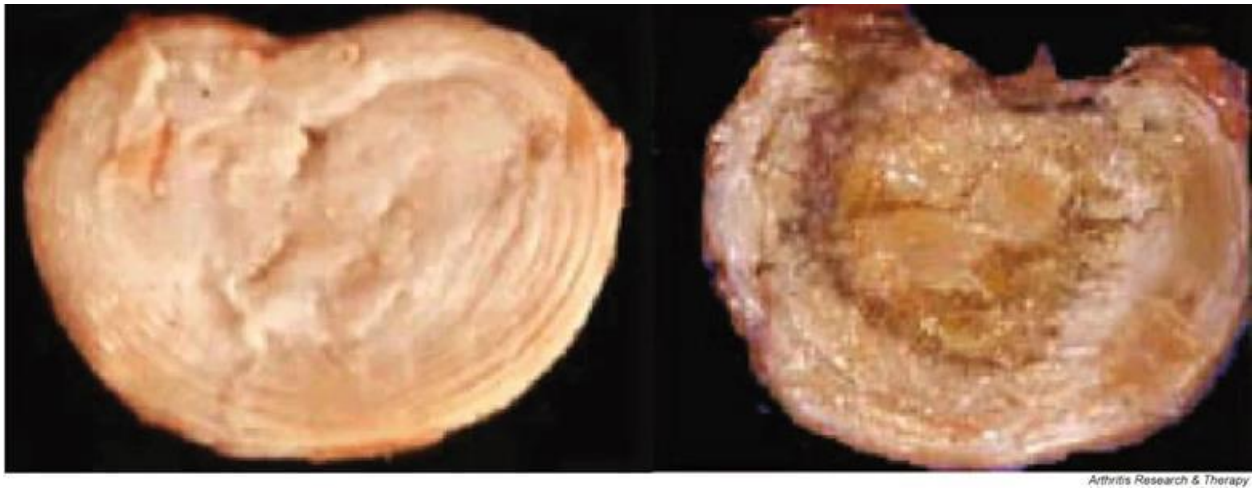

Figure 5: The annulus lamellae surrounding the softer nucleus puposus are visible. In the nightlight degenerate dis on the right, the nucleus is desiccated and the annulus is disorganized. – From "Arthritis Research and Therapy"

A theory called the "degenerative cascade" proposed by researchers back in the 1970s where the degenerative disc process or phases are explained by Kirkaldy- Millis suggesting that an injury to the disc such as torsion (twisting); a degeneration process begins as follows:

1) **Dysfunction**: small circumferential tears in the outer layer of the disc grow in ward. After injury mobility may be limited.
2) **Relative instability**: Inner material of the dis begins to protrude out ward thought the tears leading to decreased dis height.
3) **Re-stabilization**: osteophytes form at the margins of the disc and the changes in the disc become fixed. The vertebral segment stabilizes, reconstructs and dysfunction subsides.

The proposed theory included other factors that might influence the degenerative phases such as the muscles surrounding the spine will lose nerve endings. Once the re-stabilization process

takes place, a recovery of the injury follows, and finally a recovery happens. There are possibilities of experiencing frequent injuries to the disc with higher pain levels without the inclusion of changes in lifestyle and exercises (Haig AJ, 2002).

W. J. Mixter and J. S. Barr brought into light in 1993 (Bruni et al, 1998) the attention the lumbosciatic pain pathogenesis and its accompanying nerve dysfunction where he suggestion surgery as treatment. The basis of today's understanding of disc degeneration was possible in 1927 through 1929 by German pathologists Schmorl and Andrea where a clear discussion on the subject of herniated discs and degeneration of the spine are explained.

Pathophysiology

The degenerative process of an intervertebral disc is attributed to a cellular, pro-inflammatory, and molecular; it has been viewed as a mechanical loading, aging process, and genetic attribution. The pain experienced by a person it's a sensitization caused by the nerves' growth inside the annular fissures. Based on research we have learned that the process of disc degeneration can be as deep as the nucleus of the disc itself (Shayota et al., 2019). An attraction of inflammatory mediators occurs when the nucleus is exposed to the outer annulus and neural tissue. In addition, compared to endplates in healthy discs, those in degenerative discs exhibit a higher density of nerve fibers. Consequently, there is a leakage of pro-inflammatory cytokines, which causes hyperinnervation and hyperalgesia. According to studies, people with osteo-discogenic pain exhibit an increase in nerve growth factor (Aoki et al, 2014).

Epidemiology

It is believed that 26% to 42% of patients with cervical and lumbar osteo-discogenic are attributed to disc herniation (Urits et al., 2019). Osteo-discogenic of the lumber spine presents disc tears more frequently and increases in middle age. It is challenging to estimate the prevalence of intervertebral disc degeneration because the majority of patients are asymptomatic. Brinjinkji et al, in a 2015 review paper explained that the incidence of disc degeneration ranged from 37% of asymptomatic individuals over 20 years of age to 96% of those over 80 years of age, with a substantial rise in the prevalence through 50 years who

underwent lumbar MRI, indicating that degenerative changes are a consequence of normal aging and not abnormal processes requiring some sort of treatment.

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CHAPTER IV

Spinal Stenosis

Spinal stenosis was defined by Postacchini, 1996, as the" narrowing of the spinal canal causing clinical symptoms secondary to the spinal cord or radicular compromise". To conclude a diagnosis, a clear differentiation must be made between anatomic findings and clinical symptoms, since an anatomically narrow canal is often asymptomatic. Stenosis of the spine is related to structural change due to the aging process, genetic, or trauma-related, and also a disorder that causes pain, numbness, and weakness when the nerve roots are squeezed by a variety of pathologic reasons. This is more prevalent in the cervical and lumbar spine. The thoracic spine can be affected as well; however, this is more in connection with the herniated disc.

With spinal stenosis, the nerve roots are compressed by a variety of pathologic factors, resulting in symptoms like pain, weakness, and numbness. Each level of compression can result in a different set of symptoms depending on which region of the spine is being compressed, which calls for a specific type of treatment.

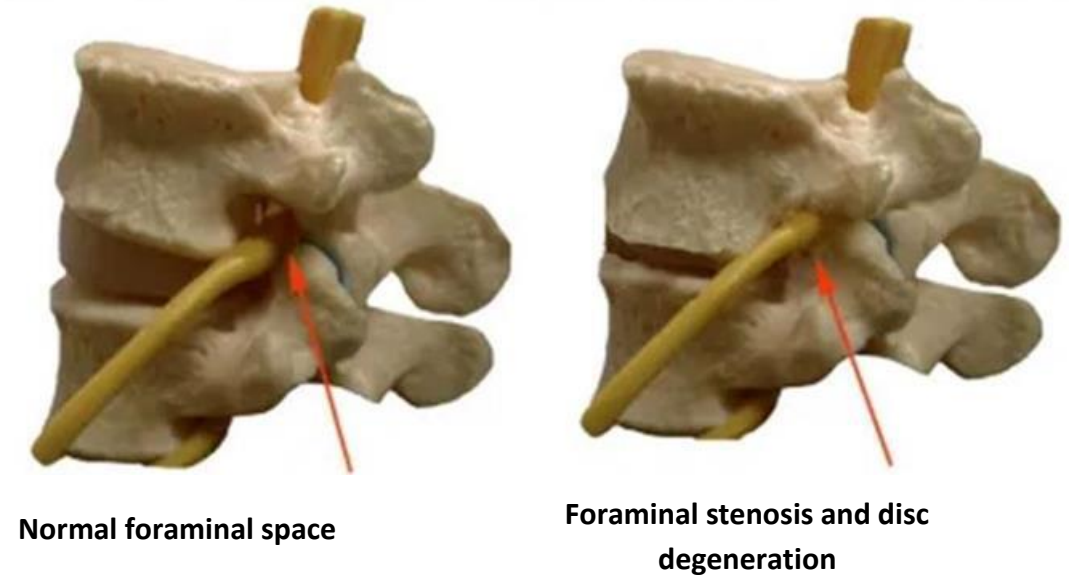

Figure 6: Decreased foraminal space causing compression of the nerve root. Costal Virginia S&P Centre

Stenosis of the spine can have a major impact in three areas:

a) **Central Canal** – this is the house of the spinal cord. It might become smaller from anterior to posterior, compressing neural tissue and reducing blood flow to the spinal cord in the cervical region and the cauda equine in the lumbar region
b) **Neural Foramen** – these are apertures where the spinal cord nerve roots leave the body. They may become compressed due to disc herniation, enlargement of the facet joints or facet hypertrophy, and unstable sliding of one vertebral segment related to the one below.
c) **Lateral Recess** – this is the space found in the lumber spine. It is the space along the pedicle where a nerve root enters just before tit leaves through the neural foramen, and it might be squeezed if there's hypertrophy of a facet joint (Tang et al, 2019; Galssman et al, 2019; Bindal et al, 2019).

Although spinal stenosis is a frequent aging condition, it is impossible to anticipate who will experience symptoms. Most of the time, altering one's way of life can stop the degenerative process.

Based on where the restricted area of the spinal canal is located, three different forms of spinal stenosis—lumbar, cervical, and thoracic—are identified. However, it is important to note that different kinds of spinal stenosis might exist. The three most common are:

a. **Cervical Stenosis**: This condition is identified when the space surrounding the top seven vertebrae of the spine becomes narrowed.
b. **Thoracic Stenosis:** This condition is diagnosed when spinal stenosis affects any location along the longest segment of the spine, which runs from the base of the neck to the belly.
c. **Lumbar Stenosis:** This is the most reported type of stenosis. It starts about six inches below the shoulder blades, which consist of the spine surrounding five vertebrae.

Etiology

Stenosis of the spine accounts for 9% of all cases. Stenosis can be of an acquired or congenital nature such as Achondroplasia, short pedicles, osteoporosis, apical vertebral wedging, spinal

dysraphism, segmentation failure early vertebral arch ossification, thoracolumbar kyphosis, morquio syndrome, and osseous exostosis are a few examples of common congenital causes.

Trauma, aging processes, iatrogenic factors, and systemic conditions are the main causes of acquired stenosis. Trauma typically causes a mechanical force to acutely impact the spinal canal. Due to ligamentum flavum hypertrophy, spondylolisthesis, and posterior disk herniation, the central canal and lateral recess narrow indicating degenerative changes. Iatrogenic spinal stenosis can result after laminectomy, fusion, and discectomy procedures (Messiah et al., 2019; Urits et al., 2019; Bagley et al., 2019; Melancia et al., 2014).

Pathophysiology

Narrowing of the vertebral canal and the lateral recesses has been attributed to stenosis of the cervical and lumbar spine, affecting spinal structures at the spinal canal causing compression of the spinal cord, adjacent nerve tissue, and cerebrospinal fluid. It has been reported that various factors can lead to the narrowing condition of the spine such as bulging or protrusion of the intervertebral disc, herniation of the nucleus pulposus posteriorly, epidural fat deposition, hypertrophy of posterior longitudinal ligament, or the ligamentum flavum, and hypertrophy of the facet joints (Melancia et al, 2014; Akar & Somay, 2019). The most common causes are osteoarthritis, degenerative disk disorders, spondylosis, and spondylolisthesis with compression of the spinal cord. Other causes include Paget's disease of bone and ankylosing spondylitis.

Symptoms

The most common cause of cervical spinal stenosis is osteo-discogenic affecting anatomical structures of the neck and lower back. Stenosis of the cervical spine can present the following symptoms – neck pain, numbness, and tingling in the arms, legs, hands, and feet. It can affect balance, difficulty using the fingers and hands during task performance, leg spasms, and loss of bladder and/or bowel control in more severe cases.

The symptoms of cervical spinal stenosis can range from being asymptomatic to including neck pain, a limited range of motion, burning or tingling sensations, and feelings of pins and

needles, weakness or numbness in the shoulders, arms, hands. Also, clumsy hand movement, balance disturbance, and gait problems can be manifested. Symptoms that are indicative of spinal cord compression (myelopathy), including loss of balance, weakness, and stiffness in the lower limbs. Patients may feel paraesthesia and weakness at the level of stenosis in the affected nerve root distribution if there is concurrent impingement on cervical roots (Wilson et al, 2013; Badhiwala & Wilson, 2017). ***Figure 2***.

Cervical Spine		
Spinal Disc	**Common**	**Diagnosis /Affected Part**
C4 – C5	Herniation	Deltoid weakness & shoulder paraesthesia
C5 – C6	Herniation	Radiculopathy
C6 – C7	Herniation	Wrist drop, paraesthesia of 2 & 3 finger
C5 – C6	Herniation	Weakness in forearm flexion and paraesthesia of the thumb and radial forearm
C7 – T1	Herniation	Weakness in the intrinsic muscles & numbness of 4 & 5 fingers

Table 2: Cervical spine diagnosis and affected parts

Lumbar stenosis common symptoms can be pain, sciatica, tingling sensations, feeling of pins and needles, weakness or numbness in the buttocks, legs, and gastrocnemius. Symptoms could aggravate when the patient walks and lessen when bending forward, sitting, or lying down. Not often a patient would experience bladder or bowel problems, or paraplegia. Stenosis symptoms often don't manifest, but with progression of the osteo-discogenic symptom comes gradually over time. The symptoms of myeloradiculopathy, neurogenic claudication, sensory abnormalities, motor weakness, and pathologic reflexes can all be caused by lumbar spine stenosis. The buttocks, thighs, and legs on both sides of the body may feel uncomfortable or fatigued, among other symptoms that are frequently present in addition to low back pain. Walking, especially long-distance walking, or standing up makes this exhaustion worse, and sitting down to rest often makes it go away (Schroeder, Kurd & Vaccaro, 2016), ***Figure 3***.

Lumbar Spine		
Spinal Disc	**Common**	**Diagnosis /Affected Part**
L3 – L4	Herniation	Knee extension & medial foot weakness, pain in the anterior thigh
L4 – L5	Herniation	Foot drop, numbness in the large toe web & dorsal aspect of the foot
L5 – S1	Herniation	Plantarflexion weakness, decreased sensation in the lateral foot drop, pain back of the leg

Table 3: Cervical spine diagnosis and affected parts

Diagnosis

A successful diagnosis of spinal stenosis is solely based on the complete patient history, physical and neurological examination, and secondly through imaging confirmation. Extended-release of X-ray, CT, and MRI imaging can be employed to make a diagnosis. Standard radiographs offer not much value in the diagnosis process with the present use of MRI, even though dynamic images in flexion and extension modes can show spondylolisthesis or dynamic instability. With the use of CT, it is possible to distinguish between soft disks and calcified disks or bone osteophytes, as well as between the ossification of the posterior longitudinal ligament and a thicker posterior longitudinal ligament, and to find bone fractures or lytic lesions. The gold standard is MRI, which can show intrinsic cord anomalies, the severity of spinal stenosis, and distinguish between other disorders such as tumors, hematomas, and infections. A CT myelogram can be used to determine the level and severity of stenosis in patients who have pacemakers and are unable to have an MRI (Shim et al., 2019) (Stienen et al., 2019) (Key et al., 2019). Additionally, the use of electrodiagnostic has been used as a tool to rule in or out differential diagnosis.

It is very important to differentiate spinal stenosis from other diseases that cause cervical and lumbar pain such as:

- Metastatic disease of the spine
- Mechanical cervical/low back pain
- Intervertebral disc herniation
- Vertebral osteomyelitis
- Compression fracture

- Discogenic disease
- Rheumatoid arthritis
- Intramedullary tumor
- Spondylolisthesis

When symptoms and findings are unclear or inconsistent with imaging results, it is important to perform an electrodiagnostic assessment before any intervention is to be performed on a patient. Researchers propose a set of criteria for using electrodiagnostic for stenosis which are as follows: mini-paraspinal mapping with a one-side score > 4 (sensitivity 30%, specificity 100%), fibrillation potential in limb muscles (sensibility 33%, specificity 88%), and absence of tibial H-wave (sensitivity 36%, specificity 92%). A composite score for paraspinal fibrillation and limbs was found to have higher sensitivity (sensitivity 48%, specificity 88%) (Haig et al, 2005).

Treatment

Once a cervical or lumbar stenosis with or without disc compression has been diagnosed, a course of treatment, treatment based on the patient's condition should be proposed. Conservative (nonsurgical) treatment is the preferred choice for patients with spinal stenosis. Often time patients can benefit from a treatment combination to help address their symptoms.

Conservative treatment can be used to treat patients with cervical stenosis not inclusive of myelopathy. If the patient has myelopathy, surgery will be indicated to release the nerve compression followed by fusion of the spine to provide stability. On the other hand, for stenosis of the lower spine, the primary treatment approach to symptoms can be done with NSAID and physical therapy in combination with pain management. The progression of the disease might require surgical decompression and fusion if myelopathy, neurologic deficits, or spinal instability develops. For both, cervical and lumbar stenosis the approach to surgical intervention can involve the anterior, posterior, or lateral restoration of the lordosis and decompress the stenosis to promote functionality (Levi et al., 2018), (Deer et al., 2019), (Williamson et al., 2018).

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CHAPTER V

History of Manual Therapy

Since ancient times, manual therapy has been a method used to treat patients with a variety of disorders. The use of manual therapy, such as prone traction and associated spinal manipulation, was advised by Hippocrates. He gave examples of the usefulness of various manual techniques and made suggestions for changes to the direction, speed, and frequency of manipulations, including the use of high-velocity thrust techniques. Modern Manual Therapy as a Western world seventeenth-century health treatment phenomenon, has gone under evaluation ever since giving rise to the manual techniques used today in physiotherapy, osteopathy, and chiropractic. (Paris, 2000, Bamajian & Nyberg, 1993, Lomax, 1975).

Generations of "bonesetters," manual therapists who taught the craft of technique to family members, contributed to the advancement of manual therapy in Europe. As medically trained practitioners stressed pharmaceutical methods and disregarded movement, the bonesetter's method gained popularity. Physical therapy was formally created in England in 1899 and in the United States in 1921 (Paris, 2000; Bamajian & Nyberg, 1993; Chikly, 2005). It had existed earlier in other European nations under different titles. Physical therapists use their core knowledge of how to manipulate joints and soft tissues to help patients recover from a range of diseases.

In the early 1900s, English medical doctor James Mennell and, in the middle of the decade, British doctor James Cyriax, both taught physical therapists manipulation techniques. The necessity of mechanical diagnosis and conservative therapies for musculoskeletal problems has been stressed by both Mennell and Cyriax, who adopted manual therapy within orthopedic medicine (Table 4).

Presently, manual therapy is one of the most popular therapeutic modalities in the field of rehabilitation, more specifically in the management of musculoskeletal problems. The development of evidence-based medicine in recent years has resulted in the publication of

numerous studies on manual therapy, enabling a greater understanding of the mechanisms underlying its efficacy in clinical settings.

Manual Therapy Pioneers		
NAME	**BORN**	**CONTRIBUTION**
Hippocrates	460 B.C.	Massage, Manual Therapy Techniques and Hydrotherapy
Bonesetters	17-18 cen.	Info passed from father to son.
Daniel D Palmer	1895	Reposition vertebrae using transverse processes as balance levers
Andrew T. Still	Mid-1800	American School of Osteopathy (1st Independent school) 1892
James Mennell	1912	Physical Treatment by Movement, Manipulation and Massage
Edgar Cyriax	1935	Element of Kellgren's Manual Treatment
James Cyriax	1957	Orthopaedic Medicine
Freddy Kalternborn	1961	Extremity Joint Manipulation
Stanley Paris	1963	The Theory and Technique of Specific Manipulation
Geoffrey Maitland	1964	Vertebral Manipulation
Robin McKenzie	1970	Spinal Extension for Treatment of LBP Centralization Theory
Brian Mulligan	1990	Manipulation With Movement

Table 4: Manual therapy Pioneers

Manual therapy has been used for many musculoskeletal conditions worth mentioning professions where it has become a main core for patient treatment. Here I am referring to the **Osteopathic** and **Chiropractic** professions, which are two of the most popular treatment forms of manual therapy used today.

Osteopathy, more commonly referred to as the practice of osteopathic medicine, is a type of manual therapy that targets anomalies of structure and function to support the body's natural self-healing and self-regulating processes. Stretching, massaging, and manipulating a patient's bones, muscles, and joints causes the therapy to have a positive impact. It is a patient-centered, practical approach to healthcare with a significant manual element, to put it briefly (Paulus, 2013). To diagnose and treat a variety of musculoskeletal conditions, including sciatica, back and neck pain, shoulder pain, osteoarthritis, arthritis, and postural strain, osteopathy relies on the power of human touch. In addition, the therapy is used to treat many functional issues that don't directly involve the bones and joints, including digestive issues,

otitis media, breathing issues, headaches, migraines, and breathing disorders (Line and Embase, 2010). Midway through the 1800s, Dr. Andrew Taylor Still, a former US Army doctor, created the fundamental ideas of osteopathic philosophy. He dedicatedly practiced conventional medicine in his early years. A series of tragic events that befell his loved ones, however, caused him to lose faith in the traditional medical procedures of the time (Pettman, 2007). Angered by his failure to save his wife and kids using the methods he had been taught, he started to seriously doubt the efficacy of conventional therapies of his time such as purging or cleansing, heat or blistering, bloodletting, and rectal feeding (Baer, 1987; Tan and Zia, 2007).

Dr. Still concluded that the majority of diseases are caused by faulty "lesions" or damaged joints in the musculature and skeletal systems, particularly the spine and its supporting musculature. This conclusion was reached after years of arduous research and study. As a result, he gradually began to entertain the idea that traditional bone settings could treat illnesses by re-establishing the normal functionality of certain musculoskeletal system structures (Still, 1908; Ward, 2015). Following the development of this theory, he in 1874 unfurled the flag of Osteopathy, a brand-new branch of medicine (Pettman, 2007). Due to his controversial theory that bone setting could cure disease, Dr. Still encountered a great deal of opposition and even lost the chance to share his ideas at Baker University in Baldwin, Kansas. The American School of Osteopathy was the first independent school of osteopathic medicine that he established in Kirksville, Missouri, in 1892 (Tan and Zia, 2007).

The following guidelines are suggested by Kuchera and Kuchera (1994) for how this therapy's practitioners should treat their patients:

- All parts of the human body are interrelated as a unit, therefore every individual is a unit of body, mind, and spirit.
- The body has its regulatory mechanism for self-healing and health maintenance
- A person’s well-being is dependent on the proper, smooth functioning of all structures including bones, muscles, tendons, ligaments, and organs; multiple physical and non-physical factors are the cause for symptoms of a disease or condition.

Since these principles are integrated into osteopathy, rational treatment is based on them (Hruby, 2000). Osteopaths thus tend to assist the body's self-regulatory and self-healing mechanisms by manipulating the patient's bones, muscles, and joints, thereby resolving the structural and functional abnormalities.

Chiropractic as a branch of medicine was established in 1895 by Daniel David Palmer. Palmer was born in Ontario, Canada, in 1845, but later moved to America in search of employment. He had several jobs in his early years to support himself. Palmer began focusing all of his attention on magnetic healing, a well-liked treatment at the time, shortly after almost a decade of working in a variety of professions. Uncertainty exists regarding the precise circumstances surrounding his decision to train as a natural healer and acquire magnetic healing techniques. Paul Caster, a well-known magnetic healer at the time who later served as his mentor in Mesmer's magnetic healing, was a person he met, according to Krieg (1995).

To become a chiropractor, a large number of students from Europe enrolled in this chiropractic school. According to popular belief, the first European students there started their education in 1906. Towards the beginning of the 20th century, chiropractic was introduced in the UK. A man from Liverpool named Arthur Eteson was the first British student in history to attend the Palmer School (Waddell, 2004). Chiropractic has taken longer than osteopathy to gain official recognition as a medical discipline. According to Keating, Cleveland, and Menke (2004), the General Chiropractic Council (GCC) was founded in the UK in 1994, but the legal protection of the term "chiropractor" did not occur until 2001.

Chiropractic care for patients is holistic, much like osteopathy. It holds that the body has its mechanisms for self-healing and self-regulation and sees the human being as a triune being composed of body, mind, and soul. Yet, compared to osteopathy, many chiropractors have a broader comprehension of the human being. They hold that the laws governing the universe as a whole apply to the human body and that the general health of an individual depends on the proper symbiosis of the three elements that make up life—intelligence, force, and matter. Numerous doctors of chiropractic argue that anything that differs from these can cause illnesses and other ills (Haldeman, 2004).

The main method of reducing musculoskeletal pain and discomfort in chiropractic care is usually spinal adjustment, which is frequently concentrated on the spine, vertebral alignment, and joints in the extremities. According to many chiropractors (Janse, Houser, and Wells, 1947), spinal misalignment prevents nerve signals from traveling from the brain to the rest of the body, which ultimately results in pain and disability in the body.

So, by addressing the alignment issues, chiropractic spinal or joint treatments often help the body's self-maintenance processes. Using anatomical, biomechanical, and neuromusculoskeletal bases for diagnosis and treatment, other chiropractors aim to restore function by addressing the underlying causes of the patient's symptoms.

How Manual Therapy Works?

The application of force for musculoskeletal conditions with the intention of healing using the hands is known as **Manual Therapy**. This high-level technique, Manual therapy, has in the past played a major role in healthcare when treating musculoskeletal conditions and it continues today. The approaches and methods used in manual therapy include massage, joint mobilization and manipulation, myofascial release, nerve manipulation, strain and counter-strain, and acupressure. This high-skill modality technique is employed by physical therapists for the treatment of different neuro-musculoskeletal conditions. It involves the expert manipulation of soft tissue, joints, and nerves by trained clinicians using hands-on techniques. Because hands-on manipulation can be very effective at reducing pain and tissue tension, improving quality of movement, and assisting a patient through their exercises, manual therapy is crucial for a variety of body systems.

Manual Therapy Goal

Manual therapy can be used on joints, muscles, or nerves. Emphasis varies regarding manual therapy methods of intervention and goals. The main differences between methods are the intervention's purpose, the tissue that is being stressed, and the force parameters used. The objectives of manual treatment include boosting stability, reducing pain, enhancing nerve tension and mobility, and enhancing joint movement quantity and quality, among others. The

practitioner uses manipulative techniques to treat a variety of tissues, including joints, nerves, muscles, bones, and fascia.

The manual therapy technique consists of applying passive movement to a joint, and this can be “mobilization” which is performed within a joint, and its counterpart “manipulation” performed past the normal range of motion (ROM). As well it includes muscle energy techniques (MET), sustained stretching, and high-velocity low amplitude (HVLA), high-velocity low thrust (HVLAT) techniques.

When using manual treatment, practitioners may change the force's direction, length, contact, frequency, and/or velocity as well as how often it is applied to the patient. The main goal of treatment is to achieve pain relief, improve nerve mobility, increase muscle length, and regain the normal function of a patient. Its therapeutic effects fall under three paradigms which are:

Physiological effects: Melzack and Wall in 1965 reported that MT stimulates the descending inhibitory tracts as well as lessens pain by using the pain gate theory mechanism. Inhibiting muscle spasms, which lessens tension on the periarticular structures, lowers pressure in the articular segment, or decreases nociceptor activity are some of the indirect ways that manual therapy can lessen pain (Zuzman, 1986)

Biomechanical effects: it modifies tissue extensibility and fluid dynamics by remodeling and repairing. After a manual therapy intervention, there’s an increase in tissue extensibility as a result of the creep mechanism which is the tissue lengthening due to constant force or load applied, therefore preconditioning or elongating after repeated loading (Panjabi & White, 2001). Manual therapy provides a more permanent change in tissue length when sufficient force is added during manual therapy treatment (Harms & Bader 1997) by producing microtrauma which in turn elongates collagenous tissue (Threlkeld 1992). Articular pressure can be reduced when the recurrent motion of affected joins changes fluid dynamics (Jayson & Dixon 1996, Levick 1979, Nade & Newbold 1983) by accelerating the flow and clearing synovial fluid.

Type of Manual Therapy

The various forms of manual therapy are numerous and generally fall into two categories:

- **Structural manual therapy**: This kind of manual therapy serves to treat musculoskeletal disorders like neck and back pain. It entails adjusting the spine or other bones and joints.
- **Soft Tissue Manual Therapy**: Conditions affecting the muscles, tendons, and ligaments are treated with this kind of manual treatment. It entails massage and other stretching and relaxing procedures for the soft tissues.

A comprehensive list of different manual therapy methods used in a clinician's daily practice (Pain Med, 2016; Complement their clinical practice, 2016; Akazawa et al., 2016; Beumer et al., 2016; Charles et al., 2019; Pickar, 2002):

- **Integrative Manual Therapy (IMT):** Developed by Dr. Sharon Weiselfish Giammatteo, PhD, PT, IMT-C, Integrative Manual Therapy is a distinct form of manual therapy. To address pain and dysfunction and promote the body's self-healing process, IMT employs a variety of manual therapy theories, techniques, and approaches. IMT practitioners take a holistic approach to physical therapy; they identify blockages in body systems and strive to direct your tissues to eliminate those limitations and reestablish normal function.
- **Myofascial Release:** Myofascial Release is a manual treatment technique that breaks down adhesions in sections of fascia that are supposed to glide and allow the underlying tissues to glide once more. Myofascial Release uses light and prolonged pressure to loosen tight muscles, move connective tissue, and improve blood and oxygen flow to the tissues. The fascia is a connective tissue that may either bind tissues together or allow the human body freedom of motion by allowing them to glide over one another.

  The body's shape and form are provided by the fibrous connective tissue called fascia. This tissue surrounds muscles, blood vessels, and nerves. Collagen fibers are arranged tightly together to form the fascia.
- **Muscle Energy Techniques (MET):** A muscle energy approach can make a joint that is stiff or having trouble moving a little more easily. The approach is intended to contract and relax particular muscles. This moderate isometric contraction lengthens

the muscle by using the muscle's energy to alleviate tension. Stretching can be improved with the Muscle Energy Technique.

- **Neural Tissue Tension Techniques:** The human body has a total length of 37 miles (60 km) of nerves, which constantly relay information to the spinal cord and brain. Other tissues and connective tissue cover these nerves. It is possible for a nerve to get trapped or to stick to a nearby structure, which could cause pain or impede movement in that bodily region. Methods for decreasing neural tissue tension are used to remove any tension, adhesions, or "stuck" nerves, thereby regaining optimal function.
- **Strain Counterstrain, or Positional Release Therapy:** The structural and postural problems that result from faulty neuromuscular reflexes are corrected with this approach.
- **Craniosacral Therapy:** This therapy helps release tension and enhances fluid flow by applying extremely light pressure to the body, allowing the body to repair itself and calming the nervous system.
- **Visceral Mobilization:** This is an effective manual therapy technique to release fascial adhesions in the deep tissues surrounding the organs and abdominal wall.
- **Join Mobilization:** A therapist may use passive movements on a joint to mobilize it in a variety of pressure, speed, and amplitude settings. Accordingly, they may make a small, gentle, back-and-forth movement of the joint or a larger, more forceful movement. Joint mobilization aims to ease pain while regaining the joint's ideal biomechanics, range of motion, and functionality.
- **Massage/Edema Massage:** Massage is applying pressure to bodily tissues in a deliberate, rhythmic manner. There are several different types of massage techniques, such as transverse friction, edema, effleurage, petrissage, kneading, rolling, vibration, and percussion/tapotement. The use of massage helps to break up scar tissue adhesions in recovering tissue, reduce swelling, enhance lymph fluid flow, improve blood flow to the surrounding area, provide nutrients and disperse waste products, and promote healing and tissue regeneration.
- **Manual Lymphatic Drainage:** Lymphatic massage is a specialist form of medical massage also known as manual lymphatic drainage. It can aid in the treatment of lymphedema, a condition where the body's lymphatic fluid builds up in certain

locations due to a poor ability to drain. By enhancing lymph fluid movement, lymphatic massage hopes to lessen edema.

- **Proprioceptive Neuromuscular Facilitation (PNF):** Stretching in PNF requires a high level of expertise and follows a certain pattern. The necessary responses in muscular contraction and relaxation are triggered by PNF by utilizing reflexes between the brain, muscles, and nerves.
- **Mobilization with Movement:** Mulligan Mobilization or Active Release are two names for mobilization with movement. The finding of tight tissue locations in the body by carefully evaluating and assessing. Scar tissue, adhesions, fibrosis, weakness, tightness, or stiffness may be present in these locations. Pressure is applied to the affected area to help the tissue relax and release.
- **Manual Traction:** Applying traction is pulling or exerting force against a compression point on the body's tissues. The use of traction is frequently combined with several other manual treatments, including ROM and myofascial release. In most cases, traction is followed by a set of exercises designed to strengthen the muscles in the area and support the newly stretched and released tissues.
- **Trigger Point Therapy:** When a muscle or set of muscles becomes overactive, too short, or excessively tight, it can be because of sensitive spots on the body called trigger points. "Referred pain" from trigger points is frequent.
- **Instrument-Assisted Soft Tissue Massage (IASTM):** Muscles, tendons, ligaments, fascia, and skin are the primary targets of IASTM, which is carried out with tools composed of surgical-grade stainless steel. The origin of IASTM comes from the Traditional Chinese Medicine used tools named Gua sha, IASTM has been established through research to stimulate mechanoreceptors in cells, boost fibroblastic activity, and have vascular and neurophysiological benefits when used by a qualified practitioner.
- **Cupping Therapy:** One of the earliest treatments still in use today dates back to ancient times and is known as cupping therapy. Modern studies have demonstrated that cupping therapy is effective in treating a variety of illnesses by easing pain and inflammation, enhancing blood and lymph movement, igniting the nervous system and

other bodily systems, and speeding up the healing process. The goal of cupping therapy is to aid the body's natural capacity for healing.

- **Dry Needling (DN):** To treat trigger points or hypersensitive and irritated areas of fascia and muscle, dry needling is a technique in which needles are placed into particular locations. An area of tension in the muscle may be released after the needle causes a fasciculation or little movement. Additionally, needling can improve oxygenation of the tissues, boost blood flow, and lessen central sensitization, which is an excessive sensitivity of the neurons in the immediate vicinity.

What kinds of ailments or injuries does manual therapy help with? Here is a sample of them:

- Neck Pain: pathologies of the vertebral discs, muscle spasm, hypomobility of the rib, post-operative neck pain
- Low-back Pain: pathologies of the vertebral disc, impingement/hypomobility of facet joints, stenosis of the spinal, post-operative back pain
- Thoracic spine/Mid-back Pain
- Headaches: tension headaches, migraines
- TMJ Dysfunction
- Fibromyalgia
- Hip Pain: hip dysfunction including impingement, myofascial hip pain in the gluteal muscles, bursitis of the hip, post-operative hip replacements
- Knee Pain: patellofemoral syndrome, iliotibial band tendonitis, post-operative knees, also total knee replacements
- Ankle Pain: sprains, chronic pain, arthritis of the ankle, post-operative ankle pain
- Shoulder Pain: impingement syndrome, scapular dyskinesia, frozen shoulder/adhesive capsulitis, post-surgical shoulder, etc.

Manual therapy is one of the safest and most effective treatments. It works best when used in conjunction with physical exercise and activity. Many techniques involved in manual therapy help relieve pain and restore muscle and joint function while reducing pain and restoring mobility. When manual therapy is used extensively during the last stage of rehabilitation, it can prove to be beneficial in restoring range of motion and reducing pain.

Manual therapy is a whole 'process' for patient management based on a thinking paradigm, not merely the execution of a technique (Silvernail, 2012). In its most basic form, manual therapy comprises a patient-centered concept that is comparable to many other therapy modalities. As a result, manual therapy involves more than just intervention-related aspects, such as passive movement of a joint, and, like other complex interventions (Perterson and Dieppe, 2005), also encompasses management-related aspects of patient care, such as the diagnostic procedure, interactions between patient-practitioner, movements retraining, guidance, and cognitive-behavioral factors, among others, which are frequently important factors for improving clinical outcomes for those with pain related to the musculoskeletal system.

Effectiveness of Spine Mobilization/Manipulation Therapy

The common occurrence of back and neck ailments in a wide range of patients suggests that 80% of people may encounter back or neck difficulties at some point in their active lives. Although they are less common, neck issues are still a serious health concern. Most of the time, no underlying disease can be found, and the reasons for the complaints are still unknown (Frymoyer, 1988; Nachemson, 1976).

Though manual therapy is used often to treat back and neck concerns, physiotherapy's effectiveness has only sometimes been studied in sufficient randomized clinical trials. Several investigations (Koes et al., 1991; Koes et al., in Press) have looked into the efficacy of manipulating and mobilizing the spine for back and neck issues, but these studies frequently exhibit methodological errors.

Numerous patient testimonials and therapeutic experiences attest to the efficacy of manual therapy in treating a wide range of musculoskeletal ailments. When we compare manual therapy to other frequently used therapies, it is more affordable and rarely causes side effects. In actuality, manual therapy risk is lower than most prescription medications and has a risk for undesirable reactions that are similar to exercise (Michaleff et al., 2012; Rubinstein, 2008; Carnes et al., 2010).

In a recent review by Pawel et al., 2012 were a study was done on 40 people between the ages of 45 and 60 (18 male and 22 female), and through the use of nuclear magnetic resonance (NMR) discovered physical restrictions in the spine and intervertebral disc degeneration, both

of which were accompanied by pain. They used a tensiometer electro-goniometer to establish the spinal curvature at the start and the end of the study. The participants were assigned into two groups of 20 people randomized. The manual therapy rehabilitation techniques were used monthly for the first group. Physical methods (exercises) were used to treat the second group. Each participant who was in the manually treated cohort underwent 15 procedures, including traction and mobilization of the intervertebral discs, fascial techniques related to finding the muscular-fascial release points, muscular energy techniques, electrotherapy, and instruction in self-therapy.

The main purpose of the therapy was to eliminate or lessen pain along with enhancing spinal physiological function. The examination using the spondylometric features was repeated in each group following the completion of therapy to assess the improvement during treatment objectively. Due to the decreased value of the variable in the group that had physical treatment, the percentage differences are statistically significant. The changing patterns associated with the segmental movement measures in both tested groups were more pronounced in the cervical and lumbar spine. They observed a more rapid shift in the physiological function of the spine in the group that received manual treatment.

They performed statistical analysis on the outcomes in both groups using the Shapiro-Wilk test to determine whether each parameter had a normal distribution. The parameters were calculated to establish their fundamental statistical properties and the dynamics of change for each period 1 and 2. Other additional tests were used “the Student's and the Wilcoxon test” to assess the significance of values across two assessment periods in both groups for parameters with normal distributions and characteristics with non-normal distributions, respectively. The Mann-Whitney U test was used to determine the significance of differences between the two groups for parameters without a normal distribution.

The authors came to two conclusions: first, manual therapy can be used as a preventative measure because it is an effective means of treating functional alterations and early structural changes in the spine. Second, the benefits of manual treatment over typical models of interventions for spinal pain include non-invasiveness and a lack of specialized equipment, which makes it less expensive to utilize (Pawel et al., 2012).

Recent randomized clinical trials indicated that manual therapy was superior to conventional conservative treatment techniques for treating low back and neck pain. (Aure et al., 2003; Gile and Muller, 2003). On the other hand, certain randomized clinical studies, systematic reviews, meta-analyses, and meta-analyses (Anderson et al., 1999; Assendelft et al., 2003) found little proof that spinal manipulative therapy is better than other conventional treatments for people with low back or neck pain.

When manual therapy is used on body structures, it has the potential to cause tension or motion in those structures. For therapies focusing on the joint, muscle, or nerve (Colloca, 2003), those movements have been quantified. During the joint-biased technique studies, tissues are subjected to a lot of motion and force (Herzog, 2001). Forces, ranging from 200 to 800 N, and the vertebral segment's posterior to anterior translation of about 6 mm happens during manipulation (a high velocity, small amplitude technique targeting a joint), for instance, the spine (Herzog, 2010). There may be up to 16 mm of median nerve excursion when certain procedures are said to mainly affect neurovascular structures (Coppieters, 2008).

After manual therapy treatment is performed, structural alterations in muscles and connective tissues are also reported. For instance, joint-biased treatments to the lumbar spine have been linked to the absorption of higher fluid in the disc between the vertebrae as well as clinical pain reduction (Beattie, 2010).

The mechanical force used in techniques like massage focuses primarily on muscles and other soft tissues. It is thought that this pressure will make tissues more extensible, leading to more movement between joints. Additionally, applying pressure to the tissues may aid in boosting blood flow (Weerapong, 2005). The volume of pressure applied by hand is used during spinal manual manipulation, it alters the electromyographic reaction in the lumbar paraspinal muscles (Colloca, 2003; Nougarou, 2013), and how much analgesia effect is felt during active movement. Specifically, when a greater force and impulse are applied during manipulation which in return will increase electromyographic reactions. According to studies, there may be an association between the mechanical factors generated through the application of manual therapy and the resulting neurophysiological outcomes, or more specifically, a dose-related neurophysiological response.

As an illustration, Teodorczyk-Injeyan, Injeyan, et al. 2006 found a decrease of 20 percent in cytokine concentration (e.g., TNF- and IL-1 concentration) that persisted for 2 hours following manual therapy interventions. Five minutes following manipulation of the spine, there are slight but significantly higher increases in serotonin and beta-endorphins (Vernon, 1986), and there is a 168% increase in endogenous cannabinoids immediately following manipulation (Mcpartland, 2005). The mechanisms by which endogenous pain relief occurs depend on these hormones.

Based on the above-mentioned research information, helps us to understand that by altering the high concentration of mediators of inflammation and pain, manual therapy can influence how peripheral nociceptors and inflammatory mediators interact after tissue injury has a direct effect interaction

Additionally, the results of systematic reviews indicate that pressure-related pain thresholds are lowered in reaction to manual therapy in both joints and muscles and connective tissues (Coronado, 2012; Gay, 2013). These temporary modifications offer some initial proof of the neurophysiological effects of manual therapy, though the clinical implications are not yet fully understood. Following the use of manual therapy, modifications in motor function have also been noted. The effects have been documented to include decreased motor responses, decreased muscle resting activity, and inhibition of motor neuron pool activity (Bulbulian, 2002; Dishman, 2003; Devocht, 2005; Coppieters, 2003).

Evidence has shown that the use of manual therapy can modify the state of spinal excitability by A combination of decreased facilitation and increased inhibition of nociceptive stimulation in the CNS is represented by instantly reducing nociceptive flexion reflexes (Courtney, 2010) and minimized temporal sensory summation (Bialosky, 2014; Bishop 2011). Massage and other soft tissue techniques, as well as spinal and extremity joint manipulation or mobilization, are all examples of manual treatment. A combination of manual therapy and exercise programs were integrated as part of the overall treatment procedure. Active trunk exercise program made of activation of deep muscles, and lumbar stabilizing muscles in combination with flexion distraction movement. According to him, flexion distraction was preferable for chronic symptoms whereas active trunk exercise was better when used on recurring pain patients with moderate to severe symptoms (Gudavalli et al., 2006). The

exercise routine worked for another author as well. However, the study's objective was to demonstrate the value of a combined approach rather than solely exercise (Satpute et al., 2019).

To provide answers to many of the questions that might arise during routine clinical practice, an ethical model of patient treatment and care must be integrated with a thorough understanding of scientific literature (Robertson-Preidler et al., 2017). Only in this way is it possible to have a clinical practice that can lessen the negative effects of cognitive bias and theoretical models while also improving the long-term prognosis of patients with musculoskeletal disorders.

Based on this, it is possible to convincingly support the effectiveness of manual therapy in improving the symptoms of various impairments that characterize the clinical pictures of patients with musculoskeletal problems, particularly pain and range of motion, and regarding the medium term, with a high level of patient satisfaction (Blanpied et al., 2017; Delitto et al., 2012).

Joint Mobilization and Manipulation

Spinal manual manipulation and mobilization for treatments of patients with neck and low-back pain is the best treatment available to date and widely by therapists. Even though joint manipulations are quick thrusts at the anatomical joint-end range, joint mobilizations must be gentle and graded depending on which component of the joint we are performing the procedure on. Physical therapists with manual therapy training typically perform mobilization and manipulation. The widely used Mobilization with Movement (MWM), created by Brian Mulligan, is one of the mobilization techniques used by therapists. The most intriguing aspect of Mulligan's MWM technique is that it can be applied vigorously and potentially painfully while the patient is in control and without experiencing any pain throughout the entire range of motion.

The pain must be eliminated during the technique application process for the mobilization with movement "MWM" to be effective. Research studies indicate that when compared to manipulation, MWM treatment is preferred. The only technique that can be used in a functional plane is Brian Mulligan's movement with mobilization. The MWM technique can

be applied to the spinal joints as well as the joints in the extremities. Additionally, MWM therapies have demonstrated efficacy in enhancing functional results. Some patients who suffer from headaches and neck pain may find relief from cervical spine manipulation and mobilization, at least temporarily. Despite the low rate of complications associated with manipulation, it is important to take into account the risk of unfavorable results because there is always a chance of long-term damage or even death.

Despite the effective results of manual therapy for some conditions, more research is required to find other patients who will benefit. Manual therapy has been shown to have been more efficient compared to other conservative approaches to treatment in recent randomized clinical trials for low back and neck pain.

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CHAPTER VI

Discussion

Manual therapy is used as a modality for addressing musculoskeletal conditions in a variety of patients; it has demonstrated its effectiveness in treating cervical and lumbar spine osteo-discogenic stenosis. According to earlier research (Chiradejnant, 2003; Vicenzino, 1996; Coppieters, 2003; Mclean, 2002), manual therapy interventions for the spine can significantly reduce pain even when they are not focused on the symptomatic area.

According to Chiradejnant et al., 2003, performing joint mobilizations on a patient's lumbar vertebra at a different level has no effect on how much pain is relieved or how much range of motion is restored. Thoracic spine manipulation may be a suitable substitute for or possibly a supplement to manual therapy interventions targeted at the cervical spine, according to Cleland et al., 2005 observation results in immediate improvements of neck pain when compared to placebo. In patients with lateral epicondylalgia, Vicenzino et al., 1996 research has shown that a cervical contralateral lateral glide significantly reduces pain scores, pain-free grip strength, and pressure pain threshold. The patient would feel pain relief as a result of spinal mobilizations because of the mechanisms underlying the immediate analgesic effects associated with those spinal movements. Recent research has demonstrated that spinal manipulation can activate an endogenous, descending pain-inhibitory system, leading to effects such as motor effects and sympatho-excitation in addition to manipulation-induced hypoalgesia (Korthals-de Bos 1 et al., 2003; Sterling, 2001; Mclean, 2002; Mcneely, 2006). In this way, the involvement of a central modulatory pain mechanism may help to explain why vertebral mobilization would not immediately result in a pain reduction.

In ovine (Colloca et al., 2006) and human (Kulig et al., 2004) spines, studies have shown that mechanical stimuli on spinal vertebrae because of vertebral motions that occur not just at the segmental contact but additionally in the closest vertebral segments. In light of this, mobilizing any cervical vertebra would cause motion to be generated across multiple cervical segments, one of which might be the symptomatic segment. It remains to be determined if this motion propagation would be sufficient to account for clinical improvement. Immediately

after spinal mobilization, changes in muscle activity may be responsible for pain reductions, especially during the most symptomatic active movements. Joint mobilization has been shown to immediately and significantly alter the functional activity of the trunk muscles in people with chronic low back pain, according to research by Ferreira et al., 2007. These sudden adjustments in muscle tone could be due to the mobilization of the spine, which alters the excitability of motoneuron cells, or they could be due to changes in higher centers' output (Ferreira et al., 2007). Reduced EMG activity of the superficial neck flexor muscles is another result of posteroanterior spinal mobilizations (Maitland, 2001; Bronfort, 2004). So, after spinal mobilizations, immediate motor changes might lead to less painful active movements.

Another important aspect of performing mobilization/manipulation therapy is the understanding of the impact muscles with relation to intervertebral joints and intervertebral discs in the following sequence of change:

1. Muscles contract similar to the myotatic stretch reflex in response to torsion brought on by overstretching, violent stretching, or disruption in the dynamic balance within the joint;
2. To protect the joint from harm, the myotatic stretch reflex is expressed;
3. Muscular contraction restricts movement in joints where attachments are present, compressing the surfaces of the joint, causing the fibrous ring to swell, and placing too much strain on the intervertebral joints;
4. Neurological symptoms may be brought on by bulging that presses on the nerve root.
5. Increasing intra-articular pressure acts on overloaded intervertebral joints, stretching and irritating the joint capsule;
6. A protective contraction of muscles may result from irritated nerves supplying the joint capsule (sinuvertebral).

These results in a disruption in the movement of the joints, which is then exacerbated by an increase in the tone of the periarticular tissues, resulting in the joint block causing functional spinal problems and additional changes in structure (Maigne, 1975).

Since manual therapy is a successful way of treating functional changes and early structural changes in the spine, it may also be used as a preventative measure.

It can also be used as a complementary therapy model of care for treating spinal pain. Its benefits include non-invasiveness and no need for specialized equipment, thereby rendering it inexpensive to use.

Thesis Case Study: Patient Manual Therapy Treatment

Patient History: Patient, a female 46 years old presented to the clinic with lumbar and cervical pain. An accountant by profession, she spends 8 hours on a desk job. The patient enjoys fitness activities such as cardio, strength training cardio combination, dancing, cycling, and yoga. During the examination the patient stated that the pain happens when coming up from forward flexion, and when going on extension/with rotation to either side. Also when lying on her back and trying to come up from that position it does exacerbate the pain. The cause of her problem was unknown. After an MRI the orthopaedic surgeon indicated that it's an old injury and the state of the spine is that of an 80-year-old person. MRI shows degenerative disc from C7 – L2, compression collapse of the Th12 with reduction of height without signs of edema within the broken body of Th7 – Th8 and Th9 – Th10. Slight protrusion of the intervertebral disc with slight pressure on the sac. Also, there's partial dehydration of the lower segments of the spine L2 – L3. And slight deviation of the spine (scoliosis) due to the mechanism used by the patient to control pain during extension, flexion, and rotation.

Diagnosis: Osteo-discogenic with stenosis degenerative of L4 - L5, fracture of the Th12, L1, L2 shaft, Postural scoliosis, and contracture quadratus lumbarum (QL).

Treatment: A 10-week treatment of manual therapy combined with other treatment modalities which included: TENS, Massage, Manual therapy, Dry Needle, Ice and Heat compression, Exercise, and Stretching.

Stage 1 – Pain reduction. To accomplish this, TENS was used to reduce the pain before any manual therapy was performed. TENS was applied 2 times a day. In addition, due to the pain control mechanism imposed on the back muscles relaxation massage was also used after TENS targeting the erector spine and quadratus lumbarum (QL) muscles. The patient was

given clear instructions to apply heat and cold compressions to speed up tissue regeneration in combination with the previously mentioned therapy.

Stage 2 – The patient was closely monitored during the stage one. Pain reduction was significantly reduced but mobility was impeded strategy used as a pain control management attributed to fear of getting back the pain and further damage to Th12, L1, and L2. During stage 2 Mulligan techniques were introduced to promote mobility and range of motion with pain reduction in forward flexion, extension, and lateral side bending to the right side.

Stage 3 – During the treatment process after 5 weeks major improvement was experienced by the patient. To complement the treatment kinesiology taping was used to help maintain progress achievements. Cervical traction was performed due to cervical stenosis manifesting peripheral pain. Also at this stage supervised group exercises were introduced and prescribed to be performed at home exercises twice a day on a pain level of 1 or less, and group exercise 3 times a week.

Home Exercises:

Group exercise classes Exercises were presented in portions. The patient joined yoga and Pilates classes 3 times per week. Stretching was achieved during these classes. Pain and any other discomfort were encouraged to keep a log of.	Bridges, Yoga spinal roll Yoga lying rotation, Cobra Pigeon pose, Downward dog Upper dog, Yoga sun salutation Pilates leg stretches, Saw rotation Side plank, Frontal plank
Home exercises The home exercises are to be performed 2 times a day on days off from Pilates and yoga classes.	Bridges SNAG passive extension w/belt Pilates spinal roll Camel cat or quadruped exercise Cannonball without rolling

Table 6: Exercise prescription

Mulligan Methods Used

SNAGS – Prep for Seated thoracic rotation

SNAGS – Seated thoracic rotation

SNAGS – passive extension (lying)

SNAGS – passive extension (lying)

GATE TECHNIQUE – 1st variation

GATE TECHNIQUE – 2nd variation

SNAGS – Prep for Seated Forward flexion

SNAGS – Seated Forward flexion

NAGS – with Lion exercise initial position

SNAGS – with Lion exercise end position

Figure 7: Mulligan methods treatment

When manual therapy such as Mulligan, Mckenzie, and others are combined with other modalities to treat an early musculoskeletal condition in the acute stage, the result will always be positive, however, when introduced during the chronic stage, a more aggressive treatment plan needs to be prescribed and full patient cooperation must be paramount for success. It is important to modify the manual therapy techniques to effectively suit the patients and avoid grievance. The effectiveness of the treatment depends greatly on the practitioner's skills.

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CHAPTER VII

Conclusion

The aging growing population is likely to lead to an increase in degenerative diseases like spinal stenosis conditions. The necessity for spinal stenosis therapy will continue to grow in the years to come as a result of proper research, a better understanding of the condition, and demands for a better quality of life. The use of Manual therapy has a long history within the profession of physical therapy and many physical therapists have greatly contributed to the current diversity in approach and techniques. Although mechanical explanations were favored to understand further the mechanisms by which manual therapy interventions were thought to work, there is a limited number of research evidence for intricate neurophysiologic mechanisms and we should also not overlook the benefit of the psychological effects of providing hands-on examination and intervention.

Not much research abounds on the effectiveness of manual therapy interventions for a wide variety of neuromusculoskeletal conditions and clinical prediction rules. In everyday practice, manual therapy is a favorable treatment option for neck pain and lumbar pain used by physical therapists when compared to continued care by a general MD practitioner.

In the past, there was no reliable data to help determine whether to treat this condition conservatively or surgically. Today we understand, based on the limited variety of research available, how effective manual therapy can be on patients with osteo-discogenic stenosis of the cervical and lumbar spinal. For example, a traction technique is the gold standard for treating cervical spine conditions by efficiently reducing pain and improving functional outcomes.

There are three main recommendations I would like to suggest for the validity of all interventions or treatments used with patients:

a) Clear group clinical examination before MT is used as an intervention modality.

b) Exercise programs have been said to have a major effect on better patients' treatment outcomes, but it will be important to know a standard series of exercises.

c) Exercises that can be used with specific pathology

In conclusion, manual therapy is being increasingly recognized as the effective gold-standard treatment for a variety of conditions. However, further research work is needed to determine the long-term benefits of using joint mobilization at specific vertebral levels. Cervical and lumbar joint mobilizations and/or manipulation so far we understand it delivers immediate pain reduction during movement and palpation in patients with chronic pain caused by cervical or lumbar osteo-discogenic stenosis and can improve range of motion, and reduce inflammation.

Appendix

Document used to obtain patient consent and permission at a clinical facility.

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CONSENT FORM FOR PARTICIPATION IN THE STUDY
FACULTY OF HEALTH SCIENCES

NAME AND SURNAME:

TITLE OF MASTER'S THESIS:

I confirm with my signature that I have read and understood the content of the information about the research procedure on the subject: ……..……
led by……..……– student of the …… year of Doctor of Physical Therapy in the field at the National University of Medical Sciences - Spain.
I have received satisfactory answers to every question regarding this study and I agree to participate in it, provided that the results of the research will be used for the public good in a way that prevents the identification of the respondents as per the Spanish Data Protection and Digital Rights Act 3/2018. In addition, I have been informed that I may terminate my participation in this study at any time without giving any reason or justification.

Participant Signature/Date

……
Name and Surname of a Student

……
Student ID
National University of Medical Sciences
Faculty of Health Sciences

National University of Medical Sciences
Luis Fuentes Bejarnao 60, L0C 2BIS,
41020, Sevilla Spain
34 919032336

APPLICATION FOR CONSENT TO CONDUCTING THE STUDY

Mr/Ms ……..……
Name and surname of the decision-making person

……..
position and name of the institution

Dear Sir/Dear Madam,

I am kindly asking you to allow me to conduct an individual research study which will allow me to collect data for the preparation of my diploma thesis on
„……
……..…….".
The participation and survey completion is voluntary and anonymous. I undertake to comply with the provisions of the Personal Data Protection Act and to maintain professional secrecy.

Application approved/unapproved

The Applicant's Signature

Signature Of The Decision-Making Person