

Lumbar spine: anatomy and biomechanics in maintaining joint stability



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Low back pain affects approximately 60%-85% of adults during some point in their life and whilst a large majority of individuals experience mild and self-limiting symptoms with 90% subsiding within 6 weeks, there are a minority of individuals with chronic, intractable symptoms which go forth to impact on quality of life and create economic implications (Middleton & Fish, 2009).

This condition presents a significant burden on both the individual and supporting family members, as well as pursuing financial ramifications on society. This essay will discuss an overview of the lumbar spine and the importance of the anatomy and biomechanics in maintaining joint stability, as well as an in-depth analysis of lumbar spondylosis and the role joint mobilisation plays in the assessment and treatment of this condition. Finally, the relevance of joint mobilisation in the field of myotherapy treatment will be debated, as the pursuit of a 'gold-standard' treatment for chronic low back pain continues.

At each level of the spine, except for C1-C2, there is what is known as a 'three-joint complex' or motion segment, which is formed by the three articulations between adjacent vertebrae: one disc and two facet, or zygapophyseal, joints. The spine is therefore considered to be a structure that is composed of multiple motion segments that are connected in a series, with the total motion a composite of motion in the individual segments (Waxenbaum & Futterman, 2018). At each level, the inferior surface of the superior vertebral body articulates with the superior surface of the inferior vertebral body through intervertebral discs (IVDs). There are 25 discs in the spine (7 cervical, 12 thoracic, 5 lumbar and 1 sacral) and account for approximately 25%-33% of the length of the spine. They allow the spine to

be flexible and moveable without sacrificing a large portion of strength (Waxenbaum & Futterstockman, 2018). They are also responsible for providing a shock-absorbing effect in the spine and prevent the vertebrae from coming into contact with each other and essentially 'grinding' together. They consist of three major components: the inner, the nucleus pulposus, the outer, annulus fibrosus, as well as the cartilaginous end-plates that stabilise the discs to the adjacent vertebrae (Waxenbaum & Futterstockman, 2018).

The nucleus pulposus is a gel-like structure that is located at the centre of the IVD and accounts for a majority of the strength and flexibility of the spine. It is comprised of between 66%-86% water with its remainder consisting of mostly type II collagen and proteoglycans (Waxenbaum & Futterstockman, 2018). The annulus fibrosus is the fibrous connective tissue that surrounds the nucleus pulposus in a ring-like shape and contains an inner and an outer portion (Waxenbaum & Futterstockman, 2018). It is this infrastructure that provides the disc with both the tension-resisting properties of a ligament, as well as the compression-resisting properties that are of articular cartilage. In the cervical spine and thoracic spine, the joint surfaces are considered as roughly planar, but not truly flat and are as such reciprocally convex in concave. In the lumbar spine region, however, the facet joints are less planar and appear to be 'boomerang' shaped when viewed from above. The cervical facet articular surface area is approximately two-thirds the size of the area of the vertebral end plate, but in the lumbar region, the facets are considerably smaller compared with the vertebral bodies (Waxenbaum & Futterstockman, 2018).

Biomechanics, which is the application of mechanical principles to living organisms, allows for the understanding as to how the bony and soft spinal components contribute both individually and collectively, to ensure stability of the spine as well as how factors such as degenerative disorders, tumours or trauma influences destabilising effects (Waxenbaum & Futterman, 2018). Stability is required within the spine in order to protect the nervous structures as well as prevent premature mechanical deterioration of spinal segments. Any vertebra in each spinal motion segment is capable of performing various combinations of main and coupled movements, including flexion, extension, rotation and lateral flexion (Waxenbaum & Futterman, 2018).

Chronic low back pain as a direct result of lumbar spondylosis, is characterised by an aching low back, with or without associated radiation to the lower limbs, with symptoms exceeding three months duration and confirmed signs of degeneration in the lumbar spine through x-ray imaging. The main feature is pain in the lumbar region most often accompanied by restriction in range of motion as well as functional limitation. There are multiple risk factors which include age, impact of activity, heredity, and occupation (Sharma, Alahmari & Ahmed, 2015).

Spondylosis of the lumbar spine, the subject of focus for this essay, is a term that encompasses varying definitions. In literature, it has been utilised in many different contexts and is often discussed synonymously with terms such as spondylitis, arthrosis, osteoarthritis and hypertrophic arthritis.

Spondylosis can also be considered as the hypertrophic response of adjacent vertebral bone to disc degeneration, although osteophytes may also
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infrequently form in the absence of diseased discs. Lastly, spondylosis can also be applied to any and all degenerative conditions affecting the discs, vertebral bodies and/or the associated joints of the lumbar spine. For the purpose of this essay, this final and broad definition will be used, recognising the high incidence of comorbid degenerative changes and the dynamic interaction between adjacent discs, vertebra and neural structures that conceive the clinical pain syndromes that arise within the lumbar spine and associated nerves (Middleton & Fish, 2009).

Degenerative spinal changes are exceptionally common in population studies, with men appearing to experience more significant degenerative changes than women, with regards to both the number and severity of osteophyte formation. One study revealed that within an adult population of individuals aged over 50 years, 84% of men and 74% of women demonstrated at least one vertebral osteophyte, with increased incidence found among individuals with more physical activity, self-reported back pain or higher body mass index (BMI) scores (Middleton & Fish, 2009).

Interestingly, the radiographic evidence of degenerative symptoms within the lumbar spine among asymptomatic individuals is remarkable. MRI imaging in asymptomatic patients over the age of 60 years demonstrates disc protrusions in 80% and degenerative spinal stenosis in 20% of individuals. It is because of this that the correlation and clinical relevance between symptomatic patients and imaging findings are being more frequently questioned by practitioners (Middleton & Fish, 2009).

There are numerous treatments that can be used for low back pain, among them including vertebral mobilisation, in which the clinical objective is to restore mobility and normalise the physiology of the musculoskeletal system (Pickar & Bolton, 2012). In the 1960's, Geoff Maitland developed a method to classify these mobilisations identified as the 'Maitland Technique'. This technique is characterised by its treatment not only based on a joint mobilisation technique, but also outlining a concept that encompasses evaluation and treatment, which supports the reasoning of treatment based primarily on the clinical findings (Choi, Hwangbo, Park & Lee, 2014). Despite being a well-known technique within clinical practice, there are still very few high-quality studies that evaluate the effectiveness of the Maitland Technique in the assessment and treatment of chronic lower back pain (Shum, Tsung & Lee, 2013).

It is necessary to present the difference between spinal mobilisation and spinal manipulation. Unlike spinal mobilisations, which are slow, oscillating movements that do not require a rapid thrusting manoeuvre, manipulation involves the application of a manual, high-velocity and low amplitude thrust directed at the joint and is usually associated with an audible 'click' or 'crack' (Abram, 2011). Manipulations are not performed within Myotherapy practice and so only the application of mobilisations will be discussed within this essay.

In a systematic review by Rothschild, it was studied whether conservative treatments including manual therapies, physical medicine methods, patient education and medication, relieved pain or improved function/disability, increased patient satisfaction and achieved a global perceived effect in <https://assignbuster.com/lumbar-spine-anatomy-and-biomechanics-in-maintaining-joint-stability/>

adults with chronic low back pain (Sharma, Alahmari & Ahmed, 2015).

Results showed that exercise paired with mobilisation demonstrated either intermediate or long-term positive outcomes. Whilst different forms and techniques in manual therapy exist, including mobilisation, and all use hands as a common feature during therapy, studies have shown that manual therapy techniques provide effective relief for chronic low back pain (Sharma, Alahmari & Ahmed, 2015). There are still limited studies researching the efficacy of manual therapy on chronic low back pain, however, there has been evidence to show that lumbar mobilisation, using the Maitland technique, assists in relieving pain and normalising function (Sharma, Alahmari & Ahmed, 2015).

In research that was conducted by Verma and Goyal where they studied the pain, range of motion, and back strength in chronic mechanical low back pain before and after lumbar mobilisation. They were able to conclude that lumbar mobilisation, along with exercises prescribed to assist in the management of the pain, responded favourably to the intervention. (Verma & Goyal, 2013). In other research undertaken by Fritz and Lindsay on a single-blinded randomised control trial, it was found that a subgroup of patients who received traction and extension-oriented exercises, compared with the control group receiving only extension exercises, showed no significant differences between the two groups (Sharma, Alahmari & Ahmed, 2015).

Bhanushali, Jagtap, and Devi published literature in 2016 that performed a study including 60 subjects aged 40-60 years that were clinically diagnosed with lumbar spondylosis and fulfilled inclusion and exclusion criteria. They <https://assignbuster.com/lumbar-spine-anatomy-and-biomechanics-in-maintaining-joint-stability/>

set out to determine whether conventional therapy including transcutaneous electrical nerve stimulation (TENS) therapy and mechanical intermittent lumbar traction (MILT), with or without facet joint mobilisation, was helpful in the treatment and recovery of lumbar spondylosis. The study provided evidence to support the use of both conventional therapy and facet joint mobilisation in reducing reported pain levels and improving range of motion in patients diagnosed with lumbar spondylosis. In addition, results supported that the facet joint mobilisation was in fact more effective along with the conservative treatment, instead of conventional treatment alone (Bhanushali, Jagtap & Devi, 2017).

Despite the high prevalence of low back pain and degenerative spinal changes within the general population, the approach to diagnostic methods and therapeutic options are often varied and conflicting, resulting in continuously rising costs and inconsistent management. Given that causative factors of chronic lower back pain are often difficult to isolate, there is little consensus with regard to a definitive treatment approach. Whilst there is no current identified 'gold-standard' in treatment, conservative approaches such as exercise therapy, manual therapy; including joint mobilisation, manipulations, TENS and massage, are becoming more popular in the efforts to avoid undertaking more invasive treatment methods such as injections or surgical interventions (Middleton & Fish, 2009).

The Myotherapy Association Australia explains that myotherapy treatment can assist in the prevention, assessment, early intervention and the treatment of a range of injuries and pain complaints utilising various skill sets and treatment options including trigger point therapy, joint mobilisation, <https://assignbuster.com/lumbar-spine-anatomy-and-biomechanics-in-maintaining-joint-stability/>

cupping, stretching, dry needling, pain management and education and exercise and rehabilitation therapy (“ What is Myotherapy?”, 2019). It should be important to discuss that whilst hands-on treatment options, including joint mobilisation and massage, appear to provide some beneficial relief from pain, it is considered to be less efficacious in isolation when compared with exercise therapy. The optimal approach consists of individually tailored exercise programs, emphasising stretching and muscle strengthening, administered in a high frequency and close adherence. This, complemented with other conservative treatments including the manual therapies and non-steroidal anti-inflammatories (NSAIDs), provides the most favourable outcomes for chronic low back pain, including lumbar spondylosis (Middleton & Fish, 2009).

There is still limited research surrounding the assessment and treatment of lumbar spondylosis, however as it presents as chronic low back pain in a large proportion of individuals, it is imperative that consistent exploration into the management of this condition continue. Joint mobilisation as a treatment overall can assist in reducing pain and stiffness, however, should be used in conjunction with a specific exercise program to achieve optimal outcomes.

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