Aetiology

Spinal stenosis is a narrowing of the spinal canal. Eventually, this narrowing can press upon surrounding tissues and nerves, causing pain and other symptoms (Weinstein et al. 2010). Spinal stenosis occurs most commonly in either the lumbar or cervical region of the spine. The two main types of spinal stenosis are primary (congenitally smaller than normal spinal canal) and acquired (as a result of disease or injury to the spine) (White & Punjabi, 2008).Common causes include age and degenerative change causing thickening of ligaments, osteoarthritis, Pagets disease, and tumours (White & Punjabi, 2008).

Spinal stenosis in younger people is uncommon unless they are anatomically predisposed by a congenital narrowing spinal canal, previous trauma or surgery to the spine, spondylolisthesis, or scoliosis. (Mazanec et al., 2014.) Some people may be born with a small spinal canal that produces pressure on nerves and soft tissues and compresses or stretches ligaments for e.g., an inherited condition called achondroplasia, a defective bone formation results in abnormally short and thickened pedicles reducing the diameter of the spinal canal (NIH, 2014).

Patients with congenital stenosis often become symptomatic in their twenties and thirties (Boos & Aebi, 2008). Congenital spinal stenosis is rare and its incidence is difficult to isolate as it affects all genders, ethnicities and body types, but it tends to be more common in shorter people and in those born with achondroplasia dwarfism (Boos & Aebi, 2008).

As you age, it's natural for your spinal canal to experience some narrowing and it may not cause any symptoms. Ligaments thicken and calcify, bone spurs grow, discs bulge and bones may also enlarge and all of these issues begin to take up space in your spinal canal leading to the symptoms of spinal stenosis. Degenerative changes accounts for most cases of spinal stenosis which occurs due to structural changes or inflammation.

Symptoms:

With congenital spinal stenosis and acquired spinal stenosis, the narrowing of any part of the spinal canal places unusual pressure on the spinal cord and spinal nerve roots, causes pain and similar symptoms. Lumbar spine stenosis involves compression of the cauda equine and may result in symptoms of parathesia, weakness, heaviness in the buttocks radiating in the lower extremities, and cervical spinal may involve compression of the spinal cord affecting upper extremities and is considered more dangerous due to the nerve supply from the spinal cord to and from the heart and lungs (Turner et al. 2000). Stiffness, restricted range of movement in particular extension is often more restricted than flexion is common findings on physical examination (Fritz et al. 2014) .

Cervical myeolopathy refers to the compression of the spinal cord as a result of the cervical spinal stenosis. Symptoms include heavy feeling in the legs, deterioration in fine motor skills, intermittent shooting pain into the arms and legs on cervical spine flexion, muscular tone in the legs may be increased, hyperreflexia, positive babinski test and hoffmans reflex. In severe cases, nerves to the bladder or bowel may be affected leading to incontinence. Balance and co-ordination may also be affected (Meyer et al. 2004).

A study carried out by Hall (1985) on lumbar stenosis found that the most common symptoms were pseudoclaudication and standing discomfort (94%), followed by numbness (63%) and weakness (43%). Symptoms were bilateral in 68% are subjects. In lumbar spinal stenosis symptoms are normally worse in spinal extension and normally report little or no symptoms seated or in supine lying. The most distinguishing feature of spinal stenosis is the relationship of symptoms to posture and is one of the key features in differentiating (Mazanec et al. 2002). The flexed position "opens up" the spinal column and therefore enlarges the spaces between the vertebrae. Because keeping the lower back 'flexed' relieves their symptoms, patients will often walk with a flexed posture. Hamstring tightness is often present due to this flexed posture and may produce a positive straight leg raise test (Mazanec et al. 2002). Straight leg raise may be weakly positive although it is not a distinct indicator. Extension is normally more limited than flexion as a result (White & Punjabi, 2008).

Diagnosis

Clinical examination involves a full subjective and objective assessment. Many of the patients' complaints resemble other common conditions and therefore it is often misdiagnosed. The clinical history may also be vague and inconsistent as the symptoms vary depending on the site affected and the extent of the narrowing and the stenosis may be present at one or several levels.

Due to the nature of the condition and varying symptoms, it may be difficult to reproduce the symptoms on physical examination. Findings may be unmasked if the patient is examined after walking until reproducing the radiating pain (Arbit and Pannuelo, 2002). The shuttle walk test is often used as an objective measure as a result. (Pratt et al. 2002).

With lumbar stenosis, a careful motor examination is recommended as although leg weakness is generally mild it is present in 50% of all cases and sensory abnormalities may be present in 46-51% of patients with spinal stenosis (Katz et al. 1992). Differential diagnosis for spinal stenosis include malignancy, infection, vascular infection, peripheral neuropathy and hip disease and should be excluded by careful subjective and objective assessment. If any of the above are suspected, imaging should be performed (Mazanec et al., 2002).

With this, a full subjective and objective assessment is a considered efficient for diagnosis however to aid the determination of the appropriate treatment, the following are useful to gain a more accurate evaluation in identifying specific anatomic structure causing the stenosis, level of involvement and degree of stenosis and to rule out any other problems.

- Spinal X- ray
- Magnetic Resonance Imaging (MRI)
- Computed Tomography (CT) scanning
- CT myelogram
- Bone scan

Many people show evidence of spinal stenosis on investigation but have no signs or symptoms. CT and MRI studies in patients who are asymptomatic and younger than 40 years found 2-28% presented with spinal stenosis and therefore diagnosis should not be limited to imaging. (Meyer et al. 2008).

Often the diagnostic tool used is dependent on factors such as costs, access to equipment, skill of radiologists and patient safety. MRI is considered the best diagnosis tool as in comparison to CT, it exposes patients to less radiation and has a better soft tissue resolution. Characteristic finding on MRI include thickened ligamentum flavum, facet hypertrophy, hour glass of appearance of spinal on saggital images facet joint synovial cysts and short pedicles. The AP diameter of the normal adult male cervical canal has a mean value of 17-18 mm at vertebral levels C3-5. The lower cervical canal measures 12-14mm. Cervical stenosis is associated with an AP diameter of less than 10mm, where as diameters of 10-13mm are relatively stenotic in the upper cervical region (Swanson,2012).

De Graff et al. (2006) conducted a systematic review of diagnostic tools of lumbar stenosis and concluded due to limitations in the quality research available and differences between them, it was not possible to draw firm conclusions about the diagnostic performance and sensitivity of the tests, warranting the need for high-quality studies that evaluate the accuracy of diagnostic tests are required to improve the diagnostic policy.

Management

Severity of symptoms, functional impairment, and progression of symptoms rather than clinical classification drive decision-making for therapeutic interventions (Chester et al. 2011). In mild cases and in initial stages, conservative management is recommended before surgery is considered. A step wise pathway that progress from least to invasive to invasive treatment is suggested.

Nonoperative treatments include orthotics, rehabilitation, manipulation, exercise, NSAIDs, analgesics, education, heat and cold applications, transelectrical nerve stimulation, ultrasound, and epidural injections (Genevay & Atlas ,2010). The literature thus far is lacking on the details on the frequency or duration of nonoperative care making it difficult to determine the effectiveness of each intervention and applying it to practice.

Tomkins et al. (2010) attempted to discover the various intervention used in the treatment of spinal stenosis. The most frequently treatment reported by 76 physiotherapists included flexibility (87%), stabilization (86%) and strengthening exercises (83%), followed by heat/ice (76%), acupuncture (63%) and joint mobilization (62%) (Tomkins et al. 2010). Further research is required in order to determine the most effective treatment.

Postural advice should be incorporated into the treatment plan as many patients present with lordotic stresses in the lumbar spine and compensatory kyphosis, resulting in poor posture. Posture can be improved using education, awareness, and exercises (Fritz et al. 1997). Neural mobilization techniques are used to improve nourishment and vascular supply to neurological tissue (Rademeyer, 2003). According to the American College of Rheumatology activities and exercises encouraging flexion of the spine should be incorporated into the patients' treatment pain and avoid spinal extension or arching your back. Pilates and yoga exercises which encourage forward flexion and a straight spine should be encouraged. Self management includes avoid aggravating activities such sustained extension positions, therefore the patient will be taught to use flexed positions to relief pain you can control your pain safely and effectively. The use of the McKenzie method has been suggested for the treatment of spinal stenosis however McKenzie (2003) reported spinal stenosis is a non-responding condition to mechanical therapy, so the typical techniques used in the McKenzie Method will not help the pain from spinal stenosis and therefore is not indicated.

Spinal surgery should only be considered when conservative measures have failed to improve or symptoms are worsening and patients' quality of life is affected. The primary goal of spinal stenosis surgery is to remove spinal structure that is causing the narrowing of the spinal canal (Genevay,2010). When multiple nerve roots are involved, a fusion procedure is often used although the use of spinal fusion is still widely debated, and a range of approaches and techniques and outcomes have been observed (Gibson, 2005). Surgical

technique depends on the type of stenosis. A laminectomy was the most common procedures to treat spinal stenosis in the last decade however recent evidence linking the surgery to segmental instability has caused a shift to more conservative approaches such as a lamimotomy is a minimal invasive surgery.

A study carried out by Atlas et al. (2000) and Weinstein et al. (2014) found that subjects with severe lumbar stenosis showed greater improved post surgery than non-surgical subjects at 4 years follow up. However, in the same study patients who received non surgical intervention showed relative improved which was maintained throughout the 4 years. Like other studies in the field the authors fail to outline the non-surgical intervention therefore making it difficult to determine what contributed to the success of the subjects. A study conducted by Turner et al. (1992) found 23% of subjects required further spinal surgery therefore suggestion the short term relief associated with surgery. In the long term, there is limited evidence that surgery is no better than conservative modalities plus exercise (Gross et al., 2005). Recent research has demonstrated a co-relation between cervical and lumbar stenosis and should be considered in developing a treatment program for a patient. Stenoic cauda equine syndrome has been reported following surgical decompression of cervical stenosis (Swanson, 2012).

Most of the literature focuses on degenerative spinal stenosis due to the rare incidence of spinal stenosis in young people however the findings are applicable to the symptoms rather than the age of the patient as the studies included a variety of ages from 30 + and found similar results. Further research is warranted to determine the most effective conservative treatment however it is clear from the evidence above, surgical intervention should only be considered when all other avenues have been explored as the long term benefits are not favourable. With the evidence above and taking into consideration the anatomy and the biomechanics of the cervical and lumbar spine the following consideration should be taken in the physiotherapy treatment plan of patients with spinal stenosis.

- Self management – heat/ice/ becoming aware of aggravating activities, postural advice.
- Avoiding aggravating activites – brisk walking, prolonged extension exercises e.g. cobra stretch in pilates and avoiding any exercises that require you to arch your back.
- Modifying activities – considering cycling on a stationary bike rather than running due to the flexion nature (hands on handlebars) of cycling instead of walking/running.
- Avoid high impact activites.
- Strengthening and range of movement exercises.

An extra lumbar spine vertebrae or lumbrosacral transitional vertebrae (LSTV) is relatively common and can be seen in approx 25% of the population and is thought to be genetic. Patients with LSTV are often considered to be more susceptible to secondary spinal conditions such as spinal stenosis, intervertebral disc herniation (Bron et al., 2007). However, Elster (1998) found no difference in the overall incidence of structural pathology of the spine in patients with LSTV after studying 2,000 patients. This was further confirmed in a study by Oguz et al. (2002) who found no relation between the spinal canal diameter at adjacent levels and LSTV. Evidence suggests LSTV is a benign anatomical variation and can be treated conservatively however further research is required in order to determine the clinical significance and management (Bron et al. 2007).

References:

Ammendolia C, Stuber KJ, Rok E, Rampersaud R, Kennedy CA, Pennick V, Steenstra IA, de Bruin LK, Furlan AD. 2013. *Nonoperative treatment for lumbar spinal stenosis with neurogenic claudication.* Cochrane Database of Systematic Reviews, Issue 8

Arbit, E., & Pannulo, S. 2001. Lumbar stenosis – a clinical review. Clinical Orthopaedics. Vol 34: 137-143.

Atlas SJ, Keller RB, Robson D, Deyo RA, Singer DE. 1992. *Attempted meta-analysis of the literature*. Spine Vol 8 pg. 2-9.

Bicket, M,C., Horowitx, J., Benzon, H., & Cohen, S,P. 2014. Epidual injections in prevention of surgery for spinal pain: systematic *review and meta- analysis of randomized controlled trials.* The Spine Journal. Vol. 28. P. 141- 152.

De Graaf I, Prak A, Bierma-Zeinstra S, Thomas S, Peul W, Koes B. 2006. *Diagnosis of lumbar spinal stenosis: a systematic review of the accuracy of diagnostic tests.* The Spine Journal, Vol. 31(10):1168-76.

Elster AD. 1989. *Transitional vertebrae of the lumbar spine.* Spine Vol. 14 pg. 1373-1377.

Fritz J, Erhard R, Vignovic M. 1997. *A non-surgical treatment approach for patients with lumbar spinal stenosis. Journal of Physical Therapy.* Volume 77(9):962–73.

Fritz, J,M., Lurie, J,D., Wenyan, Z., Whitman, J,M., Delitto, A., Brennan, P., and Wenstein, J.N. 2014. *Associations between physical therapy and long-term outcomes for individuals with lumbar spinal stenosis in the SPORT study.* The Spine Journal. Vol. 14. P. 1611 – 1621.

Fritz, Julie M. Et al. *Associations between physical therapy and long-term outcomes for individuals with lumbar spinal stenosis in the SPORT study.* The Spine Journal , Volume 14 , Issue 8 , 1611 – 1621

Friedly, Janna L.; Comstock, Bryan A.; Turner, Judith A.; Heagerty, Patrick J.; Deyo, Richard A.; Sullivan, Sean D.; Bauer, Zoya; Bresnahan, Brian W.; Avins, Andrew L.; Nedeljkovic, Srdjan S.; Nerenz, David R.; Standaert, Christopher; Kessler, Larry; Akuthota, Venu; Annaswamy, Thiru; Chen, Allen; Diehn, Felix; Firtch, William; Gerges, Frederic J.; Gilligan, Christopher; Goldberg, Harley; Kennedy, David J.; Mandel, Shlomo; Tyburski, Mark; Sanders, William; Sibell, David; Smuck, Matthew; Wasan, Ajay; Won, Lawrence; Jarvik, Jeffrey G. 2014. *"A Randomized Trial of Epidural Glucocorticoid Injections for Spinal Stenosis".* New England Journal of Medicine 371 (1): 11–21

Genevay S, & Atlas SJ. 2010. *Lumbar spinal stenosis: best practice & research*. Clinical Rheumatology. Vol. Pg. 24:253-65.

Gibson JNA, & Waddell G. 2005. *Surgery for degenerative lumbar spondylosis: an updated Cochrane review.* The *Spine* Journal. Vol. 30 pg. 12-20.Rademeyer, I. 2003. *Manual therapy for lumbar spinal stenosis: a comprehensive physical therapy approach.* Physical Medical Rehabilitation Clinical Northern America Vol. 14: 103–110

Bron, J,Barend J. Van Royen, Paul I. J. M. Wuisman. 2007.*The clinical significance of lumbosacral transitional anomalies*. Journal of Orthopaedics, Belgium. Vol. 73, 687-695

Kent, DL., Haynor D.R., Larson E.B & Deyo ,R ,A. 1992.*Diagnosis of lumbar spinal stenosis in adults: a metaanalysis of the accuracy of CT, MR, and myelography.*. American Journal Roentgenol. Vol 15 : 1135-44.

Mazanec,D., Podichetty,V., & Hisa, A. 2002. Lumbar stenosis: start with non surgical therapy. Cleveland Clinic Journal of Medicine. Vol. 96 (11).

McGregor A,H., Probyn K., Cro S, Doré CJ, Burton AK, Balagué F, Pincus T, Fairbank J. 2013. *Rehabilitation following surgery for lumbar spinal stenosis.* Cochrane Database of Systematic Reviews. Issue 12.

McKenzie, RA, May, S. *The Lumbar Spine: Mechanical Diagnosis and Therapy*, 2nd ed. New Zealand: Spinal Publications; 2003: 239

Meyer F, Börm W, Thomé C. 2008. *"Degenerative cervical spinal stenosis: current strategies in diagnosis and treatment*". Dtsch Arztebl International. Vol 105 (20): 366–72

Norbert Boos, & Max Aebi .*2008. Spinal Disorders: Fundamentals of Diagnosis and Treatment. Ed. Norbert Boos, Max Aebi.* Springer.

Oguz H, Akkus S, Tarhan S, Açikgözog˘lu S, Kerman M. 2002. *Measurement of spinal canal diameters in young subjects with lumbosacral transitional vertebra*. European Spine Journal. Vol. 11 : 115-118

Pratt RK Fairbank JC, Virr A. 2002. *The reliability of the Shuttle Walking Test, the Swiss Spinal Stenosis Questionnaire, the Oxford Spinal Stenosis Score, and the Oswestry Disability Index in the assessment of patients with lumbar spinal stenosis*. **The** Spine **Journal.** Vol 27 p. 84-91

Skolasky, Stephen T. Wegener, Anica M. Maggard, Lee H. Riley. (2014) *The Impact of Reduction of Pain After Lumbar Spine Surgery*. The *Spine* Journal. Vol 17 :1426-1432

Tomkins CC, Battié MC, Hu R. 2007. *Construct validity of the physical function scale of the Swiss Spinal Stenosis Questionnaire for the measurement of walking capacity.* 2007. The Spine Journal. Vol. 32(17):1896-901

Tomkins, C, Katherine H. Dimoff, Holly S. Forman, Emily S. Gordon, Jennifer McPhail, Joyce R. Wong,& Michele C. Battié. 2010. *Physical therapy treatment options for lumbar spinal stenosis*. Journal of Back Musculoskeletal Rehabilitation Vol 23(1) p. 31–37

Turner J, Ersek M, Herron L, Deyo R. Surgery for lumbar spinal stenosis. 2000. *Surgical and nonsurgical management of lumbar spinal stenosis: four-year outcomes from the maine lumbar spine study.* The Spine Journal. Vol 25. P. 556 – 562

Weinstein JN, Lurie JD, Tosteson TD, et al. 2006. Surgical vs nonoperative treatment for lumbar disk herniation: the Spine Patient Outcomes Research Trial (SPORT) observational cohort. Jama. 296(20):2451–9

White, A.A. and M.M.. Panjabi (2008). *Clinical Biomechanics of the Spine*. Philadelphia,. PA, Lippincott.

Websites:

American College of Rheumatology. 2013. *Spinal Stenosis.* Accessed by: http://www.rheumatology.org/practice/clinical/patients/diseases_and_conditions/stenosis.asp

National Institute of Arthritis and Musculoskeletal and Skin Diseases. National Institutes of Health. *Spinal Stenosis*. 2014 .Accessed by [http://www.niams.nih.gov]