Review Article:

The Use of the Pilates Method in the Treatment of Lumbar Disc Herniation

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Executive summary

Back pain is a major public health problem in western society, with herniated lumbar intervertebral discs being one such cause of low back pain. There are a number of treatments prescribed for herniated discs including surgery as well as a wide variety of conservative approaches. The Pilates method is one such conservative approach.

There are a number of guidelines set by Pilates International, when working with clients that have suffered herniated discs. These include guidance on directions and ranges of movement of the spine and load placed on the spine.

Not only does the current literature support the guidelines recommended by Pilates International, but it supports the Pilates method in general as a successful treatment and rehabilitation of herniated discs due to its focus on balanced musculature and correction of posture.

Introduction

Back pain is a major public health problem in western society with the majority of adults experiencing low back pain at some stage in their life. In 2004-05 31% (6 million) of the Australian population reported having a long-term disease of the musculoskeletal system and connective tissue (1). Of the total population 15% reported having back problems, which can be attributed to a number of causes including muscle strain or the displacement of an intervertebral disc (1). Intervertebral disc lesions, herniated disc, disc bulge/protrusion, disc prolapse and slipped disc, are all terms referring to a herniation of the nucleus pulposus and accounts for 4% of mechanical low back pain (2).

There are a number of treatments prescribed for herniated discs including surgery such as a laminectomy, discectomy and fusion as well as a wide variety of conservative approaches including lumbar supports, bed rest, oral analgesics and muscle relaxants, spinal manipulation, physical therapy, epidural steroid injections and behavioural therapy.

Physical therapy such as the Pilates Method is one such conservative approach which is fast gaining a reputation in the successful treatment and prevention of disc herniation. This review of the current literature has been designed to investigate whether the current literature supports the guidelines set by Pilates International, when working with clients that have suffered herniated discs.

Herniated Disc – Anatomy & Causes

Intervertebral discs lie between the vertebral bodies of the spine, linking them together. They are the main joints of the spinal column and occupy one-third of its height. Their major role is

mechanical, as they constantly transmit loads arising from body weight and muscle activity through the spinal column.

The intervertebral discs are complex structures that consist of a thick outer layer of fibrous cartilage termed the annulus fibrosus, which surrounds a more gelatinous core known as the nucleus pulposus, with the cartilage end plates positioned inferiorly and superiorly. The annulus consists of concentric rings or lamellae, with fibres in the outer lamellae continuing into the longitudinal ligaments and vertebral bodies. Elastin lies between the lamellae, possibly helping the disc return to its original arrangement following bending (3). This arrangement allows the discs to facilitate movement and flexibility within what would be an otherwise rigid spine.

The American association of neurological surgeons describes a herniated disc as a fragment of the disc nucleus which is pushed out of the annulus, into the spinal canal through a tear or rupture (4). Discs that become herniated are usually in an early stage of degeneration. The spinal canal has limited space which is inadequate for the spinal nerve and the displaced herniated disc fragment. Due to this displacement, the disc presses on spinal nerves, often producing pain, which may be severe.

Not all herniated discs cause symptoms. It is estimated that around 20% of the population may have a herniated disc without even being aware if it (5). If the bulge is only small or does not press on the cord or any nerves, people may be virtually symptom free and the abnormality may simply be discovered incidentally when imaging is performed to investigate some other condition.

Disc degeneration is associated with disc herniation as it alters the disc height and the mechanics of the rest of the spinal column, possibly adversely affecting the behaviour of the other spinal structures such as muscles and ligaments (3).

Discs degenerate far earlier that do most other musculoskeletal tissues. About 20% of people in their teens have discs with mild signs of degeneration; degeneration increases steeply with age, particularly in males, so that around 10% of 50-year old discs and 60% of 70 year-old discs are severely degenerated (6). On average L4-L5 and L3-L4 level discs showed more degeneration that discs at other lumbar levels (6). Herniated discs occur more common in the lower back (lumbar spine) and to a lesser extent in the neck (cervical spine), but can occur in any part of the spine.

Disc degeneration has a major effect on the disc's load bearing ability. Loading may then lead to inappropriate stresses along the end plate and annulus. Adams & Hutton 1985 state that most intervertebral disc disorders can be associated with the mechanical failure of the annulus fibrosus, pronounced by annulus tears, fissures, protrusions and disc prolapse (7). Some of these annulus failures can be caused by a high intradiscal pressure, which in turn has an effect on a bulging disc (8).

Reasonable evidence can be obtained to support the mechanical concept of disc degeneration, particularly that originating in torsional and compressive injuries (9). Compressive loading and torsion may produce fracture of the end plate or tear of the annulus respectively, which in turn will drive the biological events. Perhaps the most pivotal development in biomedical research into disorders of the lumbar spine is the recognition of fatigue failure. Endplate fractures and disc degeneration do not require a single memorable

traumatic event: they can occur silently and progressively as a result of mechanical factors difficult to identify in epidemiological studies (9).

Due to intervertebral discs being so resilient, many disc injuries, unless preceded by a forceful extent, occur after a long period of time associated with multiple precipitating or predisposing factors, including age, occupation and sex.

Risk factors include (5);

- Being male
- Being middle age
- Occupations involving heavy or awkward lifting and bending
- Strenuous activity such as heavy lifting if one is unaccustomed to this and is unaware of correct back protecting technique
- Increased coughing, especially of a violent nature
- Prolonged sitting or driving
- Smoking
- Being overweight
- Participating is certain sports, such as weight lifting
- Having a traumatic back injury such as a fall or car accident

Many patients with herniated discs have not only developed maladaptive changes in the neuromuscular system as a consequence of the disc herniation/lesion, but may also harbor abnormal or detrimental postural and biomechanical functional deficits (10). This means we not only have to address the site of pain itself, but also address the imbalances in the entire body.

This makes the Pilates method the ideal form of physical activity as Pilates practitioners continually address the postural imbalances of the body and prescribe repertoire accordingly.

If patients with herniated lumbar discs can tolerate their symptoms for 2 months after the onset, then the success of conservative treatment is greatly increased (11). Large herniated nucleus pulposus can decrease and even disappear in some patients treated successfully with conservative care (12). This means it is highly likely that surgery can be avoided. The exception to this is patients with cauda equina syndrome or severe motor weakness (11).

Activity modification is necessary to protect the injured site, but should be done without limiting activity to the point of predisposing the patient to the negative effects of bed rest or too little activity. It is very important to find a balance as early as possible between physiologic protection and functional ranges of movement (10).

Lumbopelvic Stabilisation & Posture

Current literature supports the need to address lumbopelvic stabilisation in patients suffering herniated discs (10, 13, 14), as well as addressing postural dysfunction (10). In the presence of pathological conditions such as chronic low back pain or herniated lumbar disc there are reports that lumbar stabilizer muscle function may be disturbed (15, 16) thus upsetting the stability of adjacent vertebrae.

This supports the Pilates guidelines that also recommend increasing core stability in neutral and use of deep stabiliser muscles, starting in supine/unloaded positions and progressing into

extension direction. By initially working the body in a supine position we can unload the spine by approximately 75% (17).

It has been suggested that nerve root impairment caused by herniated discs may lead to atrophy of both type I and type II muscle fibres of the multifidus, with structural changes only at the involved level (16). With the multifidus' principle function being maintenance of posture, it is important that this muscle is retrained in patients with herniated discs. To improve atrophy of these fast- and slow-twitch muscles, patients with lumbar intervertebral disc herniation may need strength training at a fast velocity and endurance training (16).

Lumbar stabilizing exercises have been recommended to improve lumbar function in patients with lower back injury, including herniated discs so that these patients may improve the activities of daily living (13). These types of exercises may strengthen the stabilizer muscles which control and limit the free movement of one vertebra on another (13). It may also be deduced that the increased stability of adjacent vertebrae in the vertebral column may accelerate the recovery process of the herniated disc (13) This supports therapists in using lumbar stabilising exercises to treat patients with lumbar herniated discs and that with proper management and treatment, rehabilitation of a disc herniation can be reached in a relatively short period of time (14). Lumbar stabilising exercises used studies by Greathouse (2005) and Bakhtiary (2005) include exercises very similar to that used in a Pilates studio (10, 13). These include quadruped prone breathing, supine hip release – heel slides, pelvic press with knee extension, kneeling swim (appendix 1) and ball stability exercises (appendix 2). Ball stability exercises support the suggested guidelines for the Pilates studio that recommend increasing proprioception and functional work. Other studies have used similar techniques such as various balance board proprioceptive techniques to improve functional capacity and joint proprioception (14).

McKenzie states that the difficulties do not lie in treating a particular episode of low back pain, but more in the prevention of future episodes with 62% of patients attending for treatment having had episodic pain on at least 3 occasions in the past 5 years (18). One of the major predisposing factors for low back pain is poor sitting posture, with many patients complaining of increased pain while sitting or arising from sitting (18). On examination of thousands of patients, many of them from Europe and North America, the same picture emerges: those who are developing low back pain nearly always have poor sitting posture (18). A study by Wilder (1988) also demonstrated that just 1hr of sitting causes significant changes in the mechanical properties of the lumbar intervertebral disc and that lumbar disc herniations can be a direct mechanical consequence of prolonged sitting in static or vibration environments (19).

McKenzie also states that another predisposing factor is the loss of extension. A reduced range of extension influences the posture in sitting, standing and walking, creating a stooped posture. The maintenance of the slightly flexed posture creates a constant stress on the nucleus and posterior annular wall (18). Under normal circumstances this stress is relieved by moving into extension

It is therefore of particular importance to educate and reinforce upon the patient that maintenance of lumbar lordosis or neutral pelvis is critical to avoid reoccurrence of the problem (10, 18).

The whole foundation behind the Pilates method is to create balance musculature in the body, thus supporting the maintenance of a neutral pelvis and correct posture in sitting, standing and walking

Directional Preference

Pilates guidelines suggest to initially avoid flexion, lateral flexion, rotation and a combined flexion & rotation, unless directed otherwise by a treating practitioner. It is also recommended to work small pain free ROM and gradually increase range and to use neutral to extension exercises to increase stability and reduce symptoms for clients with disc herniation.

Flexion is a primary risk factor in disruption of the health disc nucleus (20). Epidemiologic studies suggest that people whose work involves repetitive bending and lifting have a 300% to 600% increased risk of acute lumbar disc prolapse (21). It is thought that bending stretches and thins the posterior annulus fibrosus in the axial direction, thus rendering the disc to prolapse if the hydrostatic pressure in the nucleus pulposus is raised simultaneously (20). This supports the guidelines to initially avoid flexion.

Intradiscal pressure increases with different positions of the body, movements, manoeuvres and exercises. When compared to standing erect, the intradiscal pressure is greatly increased once the body is leaning forward and especially once the body is loaded. (22, 17) With lifting there is also an increased vertical load on the functional spinal unit, whereby the annulus fibres are under tension because of compression of the nucleus. This further supports using deep stabilisers in neutral and unloaded positions for clients with herniated lumbar intervertebral discs.

If a torsional load is superimposed on the vertical load, the annulus fibres are placed at an especially high risk of failure and are more likely to reach their tensile failure point (21).

Combined flexion and compressive loading causes a wedge effect that tends to displace nuclear material from the narrow to the open end of the wedge, as a result of the Poisson effect (20). If the stress is sufficient to break down the internal structure of the nucleus, the wedge effect will extrude nuclear material through the posterior part of the annulus (20).

Further studies have also demonstrated that highest annulus fibre associated strains were found for the combination of axial rotation plus lateral bending (8) or combined lateral bending, flexion, and axial rotation with vibration loading (19) together with an associated maximal disc bulging (8). The results of the same studies show that the combined loading is most likely to produce higher associated fibre strains compared to single axial loading and that the highest fibre associated strains occur in small and specific regions at the disc, mostly posterolateralllly (8, 19, 20). This supports the guidelines to initially avoid flexion, lateral flexion, rotation and a combined flexion & rotation.

The McKenzie technique is often applied by allied health practitioners to establish a 'directional preference'. Directional preference is identified when posture or repeated end range movements in a single direction (flexion, extension or slide/glide/rotation) decrease or abolish lumbar mid-line pain, or cause referred pain emanating from the spine to appear to progressively retreat in a proximal direction back toward the lumbar midline ("centralisation") (18).

Exercises prescribed in accordance with a patient's directional preference significantly improve outcomes and can be used as effective pain control/elimination treatment strategies (23).

Extension exercises and postures have been shown to improve and resolve symptoms in those with specific and non-specific low back pain (18, 24)

In studies conducted in vitro & in vivo extension movements have been shown to cause an anterior migration of nuclear tissue, which conversely displaces posteriorly during flexion (25, 26). In addition, extension can decrease the compressive forces on the nerve roots (26) and unload the spine (27). This may explain the success of extension exercises in reducing posterior protrusions in some intervertebral discs (24).

McKenzie suggested that the viscoelastic properties of the living disc result in forward migration of disc material when pressure is reduced (18). Extension therefore may be said to milk the disc forward. A free disc fragment, however, cannot migrate to the anterior aspect of the disc space because the annulus that originally allowed rupture would be constricted to a smaller size that of the disc fragment (24). Because of this, McKenzie stated that if radicular pain increases with extension, extension therapy is contraindicated. However, an increase solely in low back pain without increased radicular pain below the knee is not a contraindication to extension therapy and in fact may be expected (24).

It must be pointed out the McKenzie technique should only be used by those qualified to do so, but that the associated research can assist to guide ranges of movement with clients in the Pilates setting. This reinforces the importance of Pilates practitioners developing a working relationship with allied health professionals trained in this or similar techniques.

Kopp 1986 suggested that the ability to achieve normal lumbar extension represents a good sign patients can be expected to resolve their conditions with conservative management (24). Conversely, those who could not achieve extension required surgery and had a high incidence free disc fragments or nerve root displacement at the time of surgery (24). The majority of patients in Kopp's study responded so dramatically to extension therapy, that the use of extension exercises as a therapeutic modality has since been recommended (24). It should be emphasized that extension should be performed passively; that is the intrinsic muscles of the back should not be used against gravity (24). This is due to active extension in the prone position actually increasing intradiscal pressure (17). This supports the recommendation of using neutral to extension exercises to increase stability and reduce symptoms and that supported back extension, such as, half cobras progressing to full cobras, may be most effective.

Lumbar extensor muscle strengthening has also been found to prevent the atrophy of the type II fibre multifidus muscle, increasing the size of these fibres by 11% and increasing power by 19-22% (28). This further supports the use of exercise therapy and extension based exercises in the treatment of herniated lumbar discs.

It should be noted that not all patients with lumbar disc herniation experience pain relief with extension exercises, the importance of working with allied health professionals and assessing each individual case is once again highlighted. A client with a herniated lumbar disc should commence Pilates sessions once they are out of acute pain and after treatment with an allied health professional has ruled out the need for surgery and ideally when a directional preference has been established. This means the Pilates practitioner can be confident with their choice of ranges of movement for the client that has been referred to them.

At no time should a Pilates practitioner be working their client through a range of movement that causes pain or an increase in pain. This is a fundamental guideline that Pilates practitioners must abide by at all times.

Traction

Pilate's guidelines suggest to work unloaded and increase load gradually without compression of the spine and to provide traction to the joints.

Gravitational traction has a very apparent effect on the intervertebral space and has been found to be an effective method to distract lumbar vertebrae in patients diagnosed with low back pain resulting from lumbar disc herniation, disc degeneration and segmental instability (29). A widening of the disc space is created with a stretch of the anterior and posterior vertebral ligaments creating negative intradiscal pressure that is enough to draw back the herniated disc material (29, 30) as well as providing a pushing effect from the posterior longitudinal ligament (30). This supports the suggested guidelines to apply traction to the joints. Although not as strong as using a traction device, exercises such as quadruped rocking are ideally aiming to provide a similar effect. Pilates sessions also constantly require the client to work on lengthening their spine thus assisting unloading the spine and decreasing intradiscal pressure, no matter what position the client is working in.

Once the client has increased the stability of their spine and has the strength to support, load of the spine can gradually be increased without causing compressions. This is when the client can move from unloaded supine positions to upright seated positions. They can then continue to develop strength in their spine by resisting the effects of gravity and reinforcing a correct sitting posting which they can replicate in everyday life.

Contraindicated Ranges of Movement

The aim of any rehabilitation program is to assist an individual to return to previous functional capacity in their everyday life, including work and personal pursuits and to prevent further injury. Bearing this in mind it is important that once a client who has suffered a disc herniation is stabilised, they gradually work into small ranges of contra-indicated movement monitoring their response, making sure the client remains pain free.

These ranges of movement should start by moving around a singular axis with one new exercise or increased range of movement being introduced at a time. If a flare up does occur, this enables the Pilates practitioner to know exactly which exercise possibly contributed to the pain. Extra caution should be taken when flexion is combined with rotation with increased range of movement being introduced very gradually. It is, however, a movement occurring in everyday life and so should be introduced at the right time and with caution.

The ability to move clients into contraindicated ranges of movement is also supported by the fact that large herniated nucleus pulposus can decrease and even disappear in some patients treated successfully with conservative care (12). This together with eliminating predisposing factors such as poor posture reinforce the use of conservative treatments, such as the Pilates method, for herniated lumbar disc herniations.

Conclusion

Low back pain, including that caused by lumbar disc herniation is a major health issue in society today. With correct management and education about risk factors and posture, the majority of disc herniations can be managed successfully through a conservative approach. The Pilates method is one such conservative approach that is fast gaining a reputation in the successful treatment and prevention of disc herniation. This is due to the current literature

supporting the guidelines, as set by Pilates International, that many instructors are using when working with clients that have suffered herniated discs.

Recommendations for Pilates Practitioners working with clients with herniated lumbar discs

1. Initially avoid flexion, lateral flexion, rotation and combined flexion and rotation unless directed otherwise by treating practitioner
2. Work small pain free ROM and increase range gradually
3. Use neutral to extension exercises to increase stability and reduce symptoms
4. Increase proprioception and functional work
5. Work unloaded and increase load gradually without compression through the spine – traction the joints
6. Once stabilised, work gradually into small ranges of contraindicated ROM and monitor response

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