Clinical Case Report Competition

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First Place Winner

Melissa Wong

Effects of a massage therapy program on functional lumbar hyperlordosis
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Abstract

Background
Hyperlordosis is an increase in the normal lumbar lordotic curve. This case study focuses on treatment of “Functional Hyperlordosis” which mainly involves changes to soft tissues, as opposed to “Structural Hyperlordosis” which involves bony changes of the spine. Functional Hyperlordosis is a relatively common postural dysfunction that coexists with “Pelvic Crossed Syndrome” (also called “Lower Crossed Syndrome”). Hyperlordosis is a risk factor in numerous secondary conditions including, but not limited to: lumbar facet syndrome, lumbar disc herniation, lumbar strains & sprains, as well as premature degenerative disc and joint degeneration.

Objective
To determine the effectiveness of massage therapy preceded by hydrotherapy preheats on a semi-active 32 year-old male experiencing a functional hyperlordosis with accompanying Pelvic-Crossed Syndrome and intermittent postural pain.

Methods
Six 60-minute treatments were performed over a 5 week period. Treatments started with a hydrotherapy preheat of the areas to be addressed. This was followed by manual therapy aimed at lengthening shortened, hypertoned myofascial structures. Sessions ended with instruction and demonstration of therapeutic exercises designed to lengthen shortened postural muscles and strengthen weakened phasic muscles. Progress was evaluated through postural observation & photographs, joint ROM, pelvic tilt, Schober's Test, Thomas, Patrick's, and Kendall's Tests.

Results
After the treatment series, the patient's pelvic tilt was reduced from 15 to 5 degrees. Photographic comparisons show a significant decrease in lumbar hyperlordosis. Patient reports a decrease in postural pain. Lumbar flexion increased as seen through Schobers's test results. Hip range of motion improved in extension. The Thomas, Kendall’s and Patrick's tests went from positive to negative. Head and shoulder forward posture was also indirectly reduced.

Conclusion
For this patient, a program of massage therapy was effective in decreasing a functional lumbar hyperlordosis.

**Key words**
lower cross syndrome, pelvic-crossed syndrome, hyperlordosis, postural pain syndrome, postural dysfunction, muscle imbalances, iliopsoas contracture, pelvic tilt, anterior pelvic tilt

### Overview of Functional Hyperlordosis

**Fig. 1** - Comparison of structural orientation in normal and exaggerated curvatures. (from http://fightsciencesresearchinstitute.files.wordpress.com/2010/04/9583.jpg)

### Introduction to the Condition

Functional hyperlordosis is an increase in the normal lumbar lordotic curve, with an increased anterior pelvic tilt and hip flexion. It is an abnormal posture that creates altered biomechanics (Carnes & Vizniak, 2010). For women, an anterior pelvic tilt of 5-10 degrees is considered normal. For men 0-5 degrees is normal (St John, 1991). Beyond these limits a patient may have increased risk for premature joint and disc degeneration, in addition to painful muscular conditions (Carnes & Vizniak, 2010).

In normal posture, gravity acts in a balanced line on the physiological curves of the spine, if the body's weight is shifted from this line, another part of the spine or body needs to compensate in order to restore postural stability. It is through this mechanism that abnormal stresses can cause secondary problems on compensatory structures. This is why functional hyperlordosis is a contributing factor in pathological processes such as disc degeneration and herniations, vertebral wedging, spondylosis and
Zygapophyseal joint irritation. Or as Fiona Rattray (2000) says “…the mechanical stresses will exceed the tissue's capabilities to accommodate them, resulting in tissue breakdown and overuse syndromes.” Normally lumbar facet joints carry 20-25% of the axial load of the spine, but with hyperlordosis that can increase to 70% (Magee, 2008). Poor posture is one of the primary contributors to chronic pain (Bono, 2004), so therefore a functional hyperlordosis should be corrected.

Functional Hyperlordosis is cited as a risk factor for lumbar sprains and strains. This is due to the joints being held in extension, their closed pack position, putting soft tissues like ligaments under increased postural strain. This position also increases the load carried by the zygapophyseal joints from 25% of the total to up to 70%, thereby increasing the risk for lumbar facet syndrome (Magee 2008). In fact, 15-40% of low back pain cases originate from lumbar facet joints demonstrating the effects of exaggerated lumbar extension increasing weight-bearing forces on the Zygaphyseal joint (Carnes & Vizniak, 2010).

Initially pain is felt in the tissues that are being overstretched. This pain can usually be relieved by changing positions or changing activities, thereby reducing the mechanical stress. Mechanical stresses to well-innervated joint capsules and ligaments in poor posture (Kisner & Colby, 1990) and stretched nerve fibers within muscles are the primary origin of the intermittent pain associated with hyperlordic postures (Mumenthaler, 1992; St. John 1994). Pain may also be caused by trigger points, ischemia due to hypertonicity or squeezed capillaries and muscle spasms. Compensatory injuries such as lumbar strains and tissue degeneration as seen in osteoarthritis may also cause pain.

Etiology
Functional Hyperlordosis may result from increased weight of the abdomen during pregnancy or extreme obesity, weakened abdominal muscles, sustained poor postures, prolonged standing, bilateral IT band contracture or pes planus. (Rattray 2000).

Anatomy
Hyperlordosis affects structures surrounding both the hip and lumbar region. The lumbar spine consists of 5 large vertebrae with large, kidney-bean shaped vertebral bodies, superior and inferior facets orientated in the coronal plane, and prominent spinous & transverse processes. The processes serve as attachment points for lumbar ligaments and muscles. Between each vertebral body lies a fibrous disc that serves as cushioning between bony segments. Laterally, the lumbar vertebrae form intervertebral foramen through which spinal nerves exit the spinal cord, going to the lower limbs.

May muscles in the area provide means for motion. The rectus abdominus and obliques flex the lumbar spine, while the iliopsoas, multifidi and erectors spinae group serve to extend it. Rotation is achieved through activation of the rotatores, multifidi, erector spinae group, obliques, quadratus lumborum and semispinalis muscles. Lateral flexion is facilitated by the erector spinae, semispinalis, quadratus lumborum, rectus abdominus and the obliques. Superficially and connecting to many structures in their respective areas lies the abdominal and thoracolumbar fascia. It is composed of superficial and deep layers: superficial being composed primarily of areolar connective tissue with blood vessels and nerves throughout. Deep fascia is composed of irregular, dense connective tissue and envelopes specific muscular structures.
Pathophysiology
Muscles can be classified as postural or phasic, both react differently to prolonged stresses. The former tend to shorten and become hypertoned, while the latter weaken and are susceptible to overstretching (Magee 2008). Therefore, over long periods of time maintained abnormal postures, such as those related to occupation, cause shortening of postural muscles and lengthening of weakening phasic antagonists (Rattray 2000). Fascia overlying the muscles also follows this pattern respectively. Capillaries and sometimes larger vessels are pinched and nerve transmission may also be compromised due to either overstretched tissue or being pinched by hypertoned postural muscles.

Hyperlordosis is precipitated by a gradual Pelvic-Crossed Syndrome (also called lower cross syndrome) in which prolonged sitting postures facilitate shortening of hip flexors which anteriorly rotate the pelvis due to their attachment points, thereby promoting abnormal lumbar hyperlordosis. These shortened muscles inhibit their antagonist muscles in the hamstring and gluteal regions which eventually stretch, tighten, and weaken. At the same time, the stress of increased lordosis stimulates contracture of the shortening lower back muscles and fascia to stabilizes the abnormal posture. This inhibits the trunk flexor muscle creating a “pelvic cross” of muscle imbalance (Magee 2008).

Since the joints of the spine and hips must adjust to compensate for the shifted center of gravity, in order to maintain an upright posture, they take on new weight-bearing forces and engage in altered biomechanics. Over time, these forces exceed the body's ability to compensate, causing structures prematurely degenerate. To summarize what has been said above, shortened (or contractured) hip flexors and lumbar extensor muscles inhibit their antagonist muscles, resulting in inhibited (or
overstretched) hip extensors and trunk flexors. This pattern of muscle imbalance has been named Pelvic-Crossed Syndrome (Janda in Twomey, 1987) and is cited as a risk factor in lumbar disc herniation in combination with poor core strength and tight hamstrings (Carnes & Vizniak, 2010). PCS is a common cause of chronic low back pain often manifesting as intermittent pain solely from a postural origin.

<table>
<thead>
<tr>
<th>Shortened/Contractured &amp; Strong</th>
<th>Lengthened/Overstretched &amp; Inhibited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumbar erector spinae, QL</td>
<td>Rectus Abdominus, External &amp; Internal Obliques</td>
</tr>
<tr>
<td>Lumbar multifidi</td>
<td>Gluteus Maximus</td>
</tr>
<tr>
<td>Iliopsoas, Rectus Femoris, Tensor Fascia Latae</td>
<td>Semitendinosus, Semimembranosus, Biceps Femoris</td>
</tr>
<tr>
<td>Adductor Longus &amp; Brevis</td>
<td></td>
</tr>
</tbody>
</table>

*Fig 3a: This table classifies how muscles are expected to present in a functional hyperlordosis (based on Magee 2008 & Rattray 2000).*

**Common Medical Intervention**

Often times, Functional Hyperlordosis may be overlooked by healthcare professionals until low back pain becomes a complaint. By this point, irreversible changes may have already occurred and treatment focus becomes symptomatic, or at best belated rehabilitation with limited prognosis leading to increased incidence of more serious pathological processes that could have otherwise been prevented.

The most common therapy for hyperlordosis is medication to reduce pain and swelling, with 80% of patients being given a prescription of one or more medications after the initial visit (Chou & Huffman, 2007a). The main types of medication prescribed are non-steroidal anti-inflammatory drugs, skeletal-muscle relaxants, antidepressants, anti-epileptics, benzodiazepines, opioid analgesics and systemics corticosteroids. It is not ideal medicate ignore orthopedic rehabilitation since a progressive lordosis may lead to degenerative disc disease or herniated discs in the lumbar spine according to Salvo (2009). Additionally, drugs can have various undesirable side-effects ranging from mild effects, such as constipation and nausea, to severe which include paralysis and seizures (Drugs.com 2009).

Other treatments include exercise and physical therapy to increase muscle strength and flexibility, wearing a back brace, weight loss and surgery (Johnson 2012).

**Research for Massage Therapy Treatment of Functional Hyperlordosis**

“The pelvis is the key to proper back posture. For the pelvis to "sit" properly on the foma, the abdominal, hip flexor, hip extensor, and back extensor muscles must be strong, supple, and balanced” (Magee 2008). Salvo (2009) states that the therapist should treat muscles of both the anterior and posterior body affecting the pelvis in a hyperlordosis. Specifically, she recommends deep strokings, kneading and myofascial release techniques to the QL, iliopsoas, and paraspinals.

An imbalance in trunk muscle strength can influence significantly lordotic curve of lumbar spine and might be one risk factor for potential low back pain (Kim et. al., 2006). Research supports the idea that an interdisciplinary rehabilitative approach that incorporates exercise, stretching, hydrotherapy, and
manual massage has the best results for functional restoration in cases of chronic low back pain (Chou & Huffman, 2007b). It is possible that a similar program incorporating these multifaceted treatments will also prove to be effective in treating Functional Hyperlordosis.

Research by Shaw, Main, & Johnston (2011) states that exercise plays a key role in long-term management of postural problems and tissue health. Without modification to activities of daily living, any improvements gained through therapy will be quickly lost. Therefore, home care should therefore target long-term lifestyle changes such as becoming more active in healthy biomechanical activities like walking, hiking, and less time spent in a sitting position of any kind.

Based on research conducted in relation to the condition etiology, pathological processes and the therapist's knowledge of expected effects of specific massage techniques, a treatment plan and therapeutic exercise protocol was created.

**Assessment (Pre-treatment)**

**Patient History**

![Common posture of this patient.](from www.crossfitinvictus.com/wod/wednesday-march-4-2009/)

The patient is a semi-active 32 year-old male presenting with a Functional Hyperlordosis and accompanying pelvic tilt of 15 degrees. His family physician first commented on the postural abnormality in 2003; the patient does not remember a specific cause and there was no external trauma. The pain is described as varying between an intermittent sharp stabbing to a dull ache in the posterior lumbar and thoracic areas. Pain is also intermittently felt in the mid-belly of upper trapezius muscles and interscapular region after a work day. The patient has sporadic “stabbing” pain around the cervical-thoracic junction (C6 to T1/2) after sleeping in excessive cervical flexion. Occasionally there is an aching around the medial middle surface of the left medial femoral condyle. Patient complains of sore feet and ankles bilaterally but says it has been better since using “SuperFeet” shoe insoles. Pains generally decrease with rest in a supine position, and increases with prolonged sitting for work.
The patient is a video game designer and subsequently spends 8 hours plus/day, for the past 15 years, seated at his computer. He indicates that he often slouches forward into a position of thoracic flexion, GH medial rotation, cervical flexion and capital extension in his chair while working. His primary physical activity is walking his dog for about 30 minutes a day. Lately, due to deadlines at work, he hasn't been walking and instead takes his dog to a field and throws a ball. Patient will not be receiving treatment from any other healthcare professional or alter his normal activities and routines other than instructed by the therapist during the treatment period to reduce other outside factors that may impact this condition.

Previous injures include:
- MVA (Dec 2011): Front-on collision @ 20km/hr, was the driver. No noticeable pain or injury.
- MVA (2008): Collision with lamp post @ 10km/hr. No noticeable pain or injury.
- MVA (1999): Rear-ended while driving going uphill. Soreness at base of neck after first day.

**Observations**
Patient presented with head slightly tipped to the right and moderate head-forward posture. Left shoulder is slightly elevated and both shoulders are moderately protracted and medially rotated. Lumbar was quite obviously hyperlordotic. Left iliac crest was slightly elevated, creating slight concave curve in the left flank in comparison to the other side. From a lateral view pelvis is greatly anteriorly rotated and knees are both hyperextended. Both feet slightly everted. Right foot is slightly flatter that the left, which has a fairly high arch.

**Palpation**
Pubic symphysis is aligned, ASIS's, and ischial tuberosities are aligned. PSIS's are aligned but seem close together, possibly indicating an outflare. Rib 12 seems depressed bilaterally. As expected, TFL, iliopsoas, rectus femoris, QL, & L/S erectors are hypertoned bilaterally. There are trigger points bilaterally in the iliopsoas, rectus femoris, and QL. Hamstrings are hypertoned. Abdominals feel soft and pliable. Left piriformis is hypertoned and tender @ 3/10 on the pain scale. Thoracolumbar fascia is adhered inferiorly and laterally.

**Movement**
Lumbar: Passive movements were asymptomatic, with moderately decreased lumbar flexion. Patient performed “sphinx” posture (passive spinal extension) without any complaints of discomfort or pain. Muscle tests of rectus abdominus and both sets of obliques revealed weakness.

Hips: Passive movements were asymptomatic, with moderately decreased hip extension. Muscles tests of QL, TFL, and iliopsoas were 5/5. Strength of gluteus maximus and hamstrings were not optimal.

**Neurological**
At the initial interview, and before and after treatments, the patient was asked if he experienced any numbness, tingling, or weakness. The patient did not experience any such neurological symptoms over
the course of this case study.

**Referred Pain**
Mild, bilateral trigger points present in psoas major (referring to lumbosacral area), rectus femoris, & QL.

**Special Tests**

<table>
<thead>
<tr>
<th>#</th>
<th>Region</th>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lumbar</td>
<td>Straight Leg Raise</td>
<td>negative, no neurological involvement</td>
</tr>
<tr>
<td>2</td>
<td>Lumbar</td>
<td>Segmental Instability</td>
<td>negative, no instability</td>
</tr>
<tr>
<td>3</td>
<td>Lumbar</td>
<td>Valsalva</td>
<td>negative, no space occupying lesions</td>
</tr>
<tr>
<td>4</td>
<td>Lumbar</td>
<td>Long Sit Test</td>
<td>negative, no pelvic rotations</td>
</tr>
<tr>
<td>5</td>
<td>Lumbar</td>
<td>Femoral Shear</td>
<td>negative, no SI involvement</td>
</tr>
<tr>
<td>6</td>
<td>Lumbar</td>
<td>Schobers</td>
<td>15 cm between dots to 24.5 cm between dots = 9.5 cm increase with flexion</td>
</tr>
<tr>
<td>7</td>
<td>Lumbar</td>
<td>Joint Play</td>
<td>Generally hypomobile</td>
</tr>
<tr>
<td>8</td>
<td>Lumbar</td>
<td>Dural Slump</td>
<td>negative, no dural lesions</td>
</tr>
<tr>
<td>9</td>
<td>Pelvis</td>
<td>Anterior Pelvic tilt</td>
<td>15 degrees</td>
</tr>
<tr>
<td>10</td>
<td>Pelvis</td>
<td>Standing Wall</td>
<td>negative, no SI fixation</td>
</tr>
<tr>
<td>11</td>
<td>Pelvis</td>
<td>ASIS to Med. Malleolus</td>
<td>same, no structural LLD</td>
</tr>
<tr>
<td>12</td>
<td>Hip</td>
<td>Kendall</td>
<td>Positive bilaterally</td>
</tr>
<tr>
<td>13</td>
<td>Hip</td>
<td>Thomas</td>
<td>Positive bilaterally</td>
</tr>
<tr>
<td>14</td>
<td>Hip</td>
<td>Patrick's</td>
<td>Positive bilaterally</td>
</tr>
<tr>
<td>15</td>
<td>Hip</td>
<td>Noble's</td>
<td>Negative, no I.T.B. friction</td>
</tr>
<tr>
<td>16</td>
<td>Hip</td>
<td>Piriformis Length</td>
<td>Left side mod. shorter</td>
</tr>
<tr>
<td>17</td>
<td>Hip</td>
<td>Ober's</td>
<td>Negative, no I.T.B. contracture</td>
</tr>
<tr>
<td>18</td>
<td>Hip</td>
<td>Ant. Glide Femur</td>
<td>Mod. hypomobile</td>
</tr>
</tbody>
</table>

**Differential Diagnosis**
Test #1 through 5, 8, 10, 11, 15, and 17 provide differential diagnoses. See above charting, these results are italicized.
Treatment Overview

Hypothesis
Targeting various levels of tissues in order to greatly increase the chances of success in the treatment. Hydrotherapy, therapeutic exercise and manual therapy to increase fascial mobility over LB and anterior pelvis and thigh. Length of iliopsoas and rectus femoris, and postural exercise to encourage normal lumbar lordosis decreases load on lumbar facet joints, and thus decrease the severity of functional hyperlordosis and anterior pelvic tilt. (This case study does not use only one type of modality as that would not be effective in treating this case, based on available information.) Encouraging the patient to engage in movement activities that normalize circulation and stimulate postural muscles in a normal position is essential to retraining the body to lay lines of fascia in a direction that stabilizes the newly rehabilitated posture.

Treatment Goals
Treatments targeted all three tissue levels: muscle, fascia, and joints. Each treatment focused on a specific area of the myofascia and joint structures involved in pelvic cross syndrome.

<table>
<thead>
<tr>
<th>Tx #</th>
<th>Date</th>
<th>Area of Focus</th>
<th>Treatment Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sept. 7/12</td>
<td>Ant. Thigh &amp; Hip Flexors</td>
<td>Decrease adhesions &amp; hypertonicity. Increase circulation.</td>
</tr>
<tr>
<td>2</td>
<td>Sept. 11/12</td>
<td>Low Back &amp; Hip Flexors</td>
<td>Decrease adhesions, Trps, &amp; hypertonicity.</td>
</tr>
</tbody>
</table>

Management Plan
Long-term goals were to decrease lumbar hyperlordosis and normalize the pelvic tilt through:
1. increasing the length of the iliopsoas and rectus femoris muscles
2. increasing fascial mobility of the low back, anterior pelvis, and thigh
3. decreasing the hypertonicity of the quadratus lumborum and adductors
4. decrease Trps iliopsoas, rectus femoris & QLs

Treatment Protocol
Six 60-minute treatments were performed over a 5 week period (with a goal of 2 treatments a week which was later modified to allow for changes to the subject's work schedule). Treatments started with a hydrotherapy preheat of the areas to be addressed. This was followed by manual therapy aimed at lengthening shortened, hypertoned myofascial structures. Sessions ended with instruction and demonstration of therapeutic exercises designed to lengthen shortened postural muscles and strengthen weakened phasic muscles.

Manual therapy started with a 3 minute sacral float or lumbosacral decompression. It was then followed
by fascial techniques applied to the lower back region, and/or anterior thigh/pelvis area depending on the focus area of that day including. Skin rolling, shearing (indirect and direct), cross hands, bowing and intermuscular fascial techniques were utilized. Active and passive range of motion was applied to the knee and hip joints primarily and the lumbar joints secondarily. Swedish techniques followed; the rate and rhythm were slow and regular with sedating intent to the hypertoned hip flexors and trunk extensor muscles. Conversely, simulating massage was applied to the trunk flexors and hip extensor muscles. Specific techniques followed the principle of general to specific to general and superficial to deep to superficial. Practically this mean broad effleurage, followed by light to deep stroking and kneading, generally then specifically. The therapist spent a great deal of the treatment time on deep ulnar border and knuckle stroking and kneading, with the intention of reducing hypertoned muscles. Mid-treatment, point pressure trigger point release was performed by palpation of a tender, taut band which referred a steady deep aching to the classic pain distribution.

After this, hold-relax active stretching was performed to lengthen shortened iliopsoas, rectus femoris, Qls and TFLs. In the second treatment, grade two joint mobilizations were applied to gap the sacroiliac joint and increase anterior glide of the the femur. Every treatment finished with a swedish clearing of the areas addressed. Patient was given pillows to support the shoulders, ankles and abdomen in the prone position, as well as head and knee pillowing in supine.

Approximate timeline for 60 treatment:
- 15 to 0 minutes: hydrotherapy preheat
- 0 to 5 minutes: assessment and updates
- 5 to 10 minutes: positioning patient and sacral float/lumsacral decompression
- 10-25 minutes: fascial techniques and ranges of motion
- 25-30 minutes: general swedish to area of focus
- 30-45 minutes: specific, deep swedish techniques & trigger point work to specific muscles
- 45 to 50 minutes: active stretching
- 50 to 55 minutes general swedish to area addressed
- 55 to 60 minutes: reassessment, getting changed, and review of homecare instructions

Therapeutic Exercise
Stretches
Iliopsoas, rectus femoris, adductors, TFL, QL, L/S erectors & multifidi: 45 seconds each bilaterally, three times a day. Should not be above a 6/10 on the pain scale.

Strengthening
Rectus abdominus, obliques, gluteus maximus, hamstrings: 10 reps to start, 3 sets every other day. Perform to fatigue with increasing sets as required. Slow, controlled movements.

Activities of Daily Living Modification (ADL changes)
Patient was instructed to become more aware of pelvic tilt while standing and to perform posterior pelvic tilting exercises. While sleeping in supine, a small pillow will be placed under the sacrum so as to flatten the lower back. Patient was advised to return to walking his dog for at least 30 mins a day, and try to work up to taking him for a second 30 minute walk later in the day. Also the therapist emphasized the importance of taking a standing break every few hours while working at his computer.
Hydrotherapy
The patient was assessed to have severely hypertoned muscles and adhered fascia in multiple areas of the body. In order to make the manual techniques more effective, a 15 minute heat application was performed at the beginning of every session. The goals were to decrease muscle hypertonicity, increase circulation and make the fascia more pliable.

Type: Treatments 1-4 warm bath, treatment 5 steam room, treatment 6 infrared sauna
Frequency: Before every treatment
Intensity: 36-38 degrees Celsius
Duration: 15 minutes
Surface area: as per tx focus that day

Results
Progress was evaluated through pelvic tilt, special tests, joint ROM, trigger points, postural observation, photographs, palpation, and subjective patient report.

Pelvic Tilt
Pelvic tilt was measured with a goniometer by the procedure described by Rattray (2000), which is found to be extremely accurate (Alviso et al. 1988). The therapist held the top arm of the goniometer at horizontal, with the device's axis at the posterior superior iliac spine. Then the other arm was positioned to be aligned with the anterior superior iliac spine. The angle of pelvic tilt was read and recorded from the device. As shown on the graph below, the pelvic tilt started at 15 degrees. After the third treatment it began to decrease, gradually at first, then more dramatically. After the final treatment the pelvic tilt was 5 degrees, which is considered to be on the high end of normal for a male (St. John, 1991). As stated previously in the introduction section, the normal position for the female pelvis is from 5 to 10 degrees of anterior pelvic tilt, while the normal position for the male pelvis is from zero to five degrees of anterior pelvic tilt.
**Special Tests**

Lumbar flexion increased as seen through Schober's test results. The Thomas, Kendall’s and Patrick's tests went from positive to negative.

Schober’s Test

The Schober test was used to measure the amount of flexion occurring in the lumbar spine. A point was marked midway between the two PSISs then, points 5 cm below and 10 cm above that level were marked. The distance between the three points was measured, the patient was asked to flex forward, and the distance was remeasured. The difference between the two measurements is an indication of the amount of flexion occurring in the lumbar spine (Magee 2008). As shown in the chart below, the distance between the three points changed from 15cm to 24.5cm, indicating a 9.5cm increase in lumbar flexion over the course of treatment.
Thomas Test
The Thomas test was used to assess a hip flexion contracture. The patient lay in supine while the therapist checked for excessive lordosis, which is usually present with tight hip flexors. The therapist flexed one of the patient's hips, brought the knee to the chest to flatten out the lumbar spine and to stabilize the pelvis. The patient held the flexed hip against the chest. If there was no flexion contracture, the hip being tested (the straight leg) remained on the examining table. If a contracture was present, the patient's straight leg rose off the table and a muscle stretch end feel was felt (Magee 2008).

Kendall's Test
The Kendall test was used to assess for rectus femoris contracture. The patient lay supine with the knees bent over the end of the table. The patient flexed one knee onto the chest and held it. The angle of the test knee should remain at 90° when the opposite knee is flexed to the chest. If it does not (i.e., the test knee extends slightly), a contracture is present (Magee, 2008). The examiner attempted to passively flex the knee to see whether it will remain at 90°. As show in the pie chart, this test was positive for treatments 1 to 4 and negative for treatments 5 & 6.

Patrick's Test
The Patrick Test was used to track the progress of contractured hip adductors. The patient lay supine, and the therapist placed the patient's test leg so that the foot of the test leg is on top of the knee of the opposite leg. The examiner then slowly lowered the knee of the test leg toward the examining table. A negative test is indicated by the test leg's knee falling to the table or at least being parallel with the opposite leg. A positive test is indicated by the test leg's knee remaining above the opposite straight leg (Magee, 2008). As show in the pie chart, this test was positive for treatments 1 to 4 and negative for...
treatments 5 & 6.

Status of Thomas, Kendall, & Patrick's Tests

(Percent of Total Treatment Period)
- Positive 66.66%
- Negative 33.33%

Fig. 7: Percent of total treatment period that Thomas, Kendall, & Patrick's tests are positive and negative.

Changes in Hip AROM (Average of Both Sides)

Fig. 8: Progression of active hip extension based on post-treatment measurements
Joint ROM

Hip
Peripheral joint exam with the use of “star chart” assessment forms (example in Appendix A) was performed to assess acetabulofemoral joint ROM. Active extension showed the greatest decrease of ROM, with a corresponding fascial and muscular pull on the anterior hip and pelvic area. The graph above illustrates the changes observed in this restricted range over the course of treatments. It started out at approximately 70% of full AROM, gradually increasing to almost full range by the final treatment.

Lumbar
Axial joint exam with the use of “star chart” assessment forms was also performed to assess lumbar spinal joint ROM. Active flexion showed the greatest decrease of ROM, with a corresponding fascial and muscular pull in the lower back area. Lumbar active flexion improved over the course of treatment from the lower back staying flat when the patient flexed forward (pre-treatment) to an even curve being observed in the same area with flexion post-treatment.

Trigger Points
Palpation reveals trigger points assessed pre-treatment are no longer present in the right QL, bilateral iliopsoas and rectus femoris. A slight referral can still be elicited from the left QL.

Palpation
An increase is palpated in the distance between rib 12 and the iliac crest, especially on the right side. Thoracolumbar fascia is still slightly adhered towards the inferior aspect, otherwise it can now be “skin rolled,” where previously it could not be. Postural muscles, including the lumbar erector spinae, QL, TFL, iliopsoas, and rectus femoris are assessed to be much more pliable: the tone has changed from stone-like (pre-treatment) to that of wet, packed sand (post-treatment).

Subjective Patient Report
Patient reports an improved awareness of his posture and an overall decrease in intermittent postural pain. The lower back feels “looser and more aligned” and his legs/hips feel “more flexible.” Homecare stretches have become easier and some “don't work” anymore. Strengthening exercises, specifically abdominal strengthening, can now be preformed at 30 plus reps, whereas before only 10 reps could be completed per set. His sleep has also improved over the course of treatment.

Postural Observation
The patient was instructed to stand in a relaxed position: feet shoulder width apart, head facing forward. Head and shoulder forward posture was indirectly reduced. Knees are no longer hyperextended in a resting upright posture. Lumbar lordosis is less exaggerated.

Photographs
Photographic comparisons show a significant decrease in lumbar hyperlordosis.
Fig. 9: Pre-treatment Anterior (Sept. 7/12)  
Fig. 10: Post-treatment Anterior (Oct. 13/12)

Fig. 11: Pre-treatment Left Lateral (Sept. 7/12)  
Fig. 12: Post-treatment Left Lateral (Oct. 13/12)
Fig. 13: Pre-treatment Posterior (Sept. 7/12)  

Fig. 14: Post-treatment Posterior (Oct. 13/12)
Fig. 15: Pre-treatment Right Lateral (Sept. 7/12)  Fig. 16: Post-treatment Right Lateral (Oct. 13/12)
Conclusion
The outcome of this study supports the hypothesis that a full program of massage therapy including

Swedish massage, fascial techniques, trigger point release and active stretches, complemented by therapeutic exercise can be effective in decreasing a functional lumbar hyperlordosis. The patient's anterior pelvic tilt was reduced from 15 to 5 degrees which correlates with elimination of iliopsoas, rectus femoris and hip adductor contractures. These changes correspond with the increase seen in lumbar flexion and hip extensor, which makes sense since these ranges could not increase until the contractures that inhibited them were resolved. Follow-ups at 3, 6, 9, and 12 months post-treatment would be valuable in evaluating the sustained efficacy of the treatment series; of particular interest would be the patient's anterior pelvic tilt angle, to see how long the correction is maintained either with or without continuation of the homecare exercises.

Through viewing his before and after photographs and practicing postural exercises, the patient reported greater awareness of this lumbar lordosis and it's balance in daily activities. It is likely that, more so than any changes achieved throughout this series of treatments, this self-awareness will prove to be the most longstanding benefit of this study.
Unexpected but notable results included the reduction of head and shoulder forward posture even though these areas were not directly targeted by any techniques used. This may have occurred as a reverse in secondary postural compensation—that is, once lumbar hyperlordosis was reduced changes the body had made to realign itself were no longer needed. This may also be a result of the patient's improved postural awareness.

While these results suggest that a comprehensive massage program is effective in treating functional postural dysfunction more evidence-based studies, with a larger number of participants over a longer period of time would eliminate other possible factors contributing to the interpretation of the study's results stemming from the use of only a single subject. Without controlled conditions of a larger sample size, conclusions about causal relationships cannot be definitively made.

A comparison study would also be advised to compare the efficiency of manual massage techniques vs. therapeutic exercise. More research is needed to identify how much of the results seen can be attributed to the therapeutic exercise rather than the manual techniques themselves. In this study, it is possible that the progression of the patient's condition may be dependent on the adherence to the home care protocol. The patient reports that he did not regularly perform the recommended number of stretching sets until after the second treatment, which could explain the initial lack of change in pelvic tilt followed by a significant reduction in the angle. By measuring pelvic tilt pre-treatment & post-treatment every session, instead of post-treatment each session only more clues could be found to this question's answer.

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### Peripheral Joint Exam

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<tr>
<td>I</td>
<td>Passive ROM</td>
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<tr>
<td>SI</td>
<td>Hypermobility</td>
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<tr>
<td>P</td>
<td>Pain in ROM</td>
</tr>
</tbody>
</table>

### Legend

- $: Active ROM
- I: Passive ROM
- SI: Hypermobility
- P: Pain in ROM

### 1. Joint Examined:

- R
- L

#### Pre-treatment

<table>
<thead>
<tr>
<th>ER</th>
<th>Flex.</th>
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#### Post-treatment

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<td>Add.</td>
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### 2. Abnormal End-feels

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<th>Quality</th>
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### 3. Restriction Pattern

- Capsular
- Non-capsular

### 4. Resisted ROM Testing

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### 5. Joint Play (C-L) Assessment

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### 4a. Manual Muscle Test (MMT)

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Appendix A: Star Chart
References


