Fatigue Posture and Pilates

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Abstract

Fatigue posture, also known as "sway back" or "slouch posture", is relatively common in certain groups such as models and dancers. Over time, this posture creates a kyphotic curve in the thoracic spine, a lordotic curve in the cervical spine, and varying degrees of flatness in the lumbar spine. A posterior tilted pelvis and hyperextended hips are key components, allowing the person with this posture to "hang" in their ligaments. In this way the skeleton self-corrects against gravity without needing to recruit the musculature to remain upright, therefore using very little energy and earning the name “fatigue”.

Pilates plays a key role in bringing the body back into ideal alignment, which in turn allows the spine to once again act as the natural shock absorber that it is meant to be when the natural curves of the spine are present/normalized. Strength is returned to lengthened and/or unused muscle groups, while allowing shortened, overworked muscles to relax and lengthen. Muscles once again take over their natural roles and no longer need to compensate for weakness in other areas of the body.
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In ideal posture, a gravity plumb line runs through the ear lobe and the shoulder joint, midway through the trunk, just anterior to the sacrum, through the greater trochanter, anterior to the knee joint, and slightly anterior to the lateral malleolus. In contrast, fatigue posture (FP) is characterized by the pelvis resting forward of this plumb line, with a generally kyphotic thoracic spine posterior to the plumb line.

FP differs from lumbar lordosis in that the pelvis is generally in a posterior tilt, as opposed to the anterior tilt found in lordosis. There is a certain amount of flattening of the lumbar curve in FP, although the degree varies from person to person. The hips are hyperextended, as are the knees, though the ankles remain neutral. Further, the earlobe and the shoulder joint also sit anterior to the described plumb line.

Due to the forward position of the head and shoulders relative to the thoracic spine, cervical lordosis is usually present, with necessarily long and weak neck flexors. Sacroiliac pain may be an issue as well as upper back, neck, and shoulder pain. Long and weak upper back extensors are present and the hip flexors are often long, while the hamstrings tend to be short and overly strong.

Fatigue Posture

Ideal Posture
FP, also known as "sway back" or "slouch posture", gets its name from the "hanging" in the ligaments that occurs, specifically the iliofemoral ligament. This ligament assists in keeping the trunk upright without activation of the musculature, hence this posture requires very little energy or effort to sustain.

Cervical and lumbar lordosis (#2 below) describes an accentuated curvature of the spine in the cervical and lumbar regions of the spine. To support the trunk and the upper extremities and to be able to remain upright with a minimum of energy use, the cervical and lumbar curves must be relatively well balanced. In particular, the lumbar curve provides shock absorption for stresses placed on the spine from gravity and activity. When spinal curvature is either reduced or increased, this inherent quality of the spine is compromised. More pronounced curvature in these regions also places added stress on the posterior aspects of the vertebrae and the vertebral discs, which can lead to pain and dysfunction. Postural muscles can also make adaptive changes, adding further to pain and dysfunctional movement patterns in the body.

**Lumbar Lordosis**

Thoracic kyphosis, though most commonly the result of postural imbalances, can also result from structural abnormalities. This element of FP, which is postural in nature, can be addressed to a large degree through strengthening of the upper back extensors. Strength is instrumental in shortening the line of the back, thus bringing the trunk and head in line with the pelvis in order to normalize posture and shock absorption.
Thoracic Kyphosis

When there is a loss of the cervical and/or lumbar curves, flat back syndrome is present, with the pelvis generally tilted posteriorly. Most often there is only a loss of the lumbar curve, as seen below, which in its most extreme case can lead to difficulty remaining upright. The lack of a full lumbar curve in FP is balanced by a certain degree of thoracic kyphosis and the forward thrust of the pelvis, which is the body's adaptation to gravity.

Flat Back Posture

When not recruited regularly, a muscle loses its ability to contract, resulting in strength reduction over time. Very strong hamstrings, often found in FP, can take over some of the work of the gluteals, especially hip extension, encouraging gluteal weakness. Thus, it is important to
teach the client the proper muscle recruitment order where appropriate. For example, in Forward Lunge, one must communicate that the hamstring muscles fire first, then the gluteals, then the quadriceps group, as there is a tendency to let the muscles of the front of the thigh do all or most of the work.

The following muscle groups contribute to FP so must also be instrumental in correcting the imbalances inherent to this posture.

The iliofemoral ligament attaches to the anterior inferior iliac spine and the intertrochanteric line. This ligament is slack in flexion and medial rotation and taut in lateral rotation and helps keep the head of the femur in the hip socket. Ligament attaches bone to bone and receives very little blood supply, making healing from injury especially slow. Ligamentous blood supply is lowest at the fibro-osseous junction, or the point at which a ligament attaches directly to a bone, which results in slow injury recovery.

One impact of overstretching ligaments is that they do not return to their original length, so it is imperative to correct the pelvic thrust aspect of fatigue posture in order to reduce the prolonged strain on the attending ligaments. As a result of possible lengthening of local ligaments in the hip area, strengthening the surrounding musculature will provide additional support to the hip joint.

The abdominal muscles bind the abdomen, providing support to the trunk and internal organs, with the muscle fibers of the four sets of abdominal muscles running against one another. They attach, generally, on the lower ribs and xiphoid process at their uppermost border, the pelvis and pubic symphysis below, and the thoracolumbar fascia. Rectus abdominus describes "six pack abs" and is the most superficial of the four, followed by the external obliques, internal obliques, and transverse abdominus (TA).
Rectus' vertical fibers medially flex the trunk. The external oblique fibers run in a downward and medial direction, flexing, laterally flexing, and contralaterally rotating the spine. In contrast, the internal oblique fibers run upward and medialward, flexing, laterally flexing, and ipsilaterally rotating the spine. Finally, TA, whose horizontal fibers create a "corset" effect and interdigitate with the diaphragm, compresses the abdominal contents, assists with (forceful) exhalation, and helps to stabilize the spine.

The iliopsoas is a combination of two muscles, the iliacus and psoas major, which share a common tendon inserting on the lesser trochanter of the femur. The iliopsoas is the strongest flexor of the hip joint and pulls the lumbar vertebrae forward into lordosis when overly tight and can create sacroiliac joint pain when an imbalance exists between the left and right psoas muscles. The psoas flexes the trunk when the femur is fixed and flexes the femur when the trunk is fixed, as well as laterally rotating and flexing the hip, while the iliacus originates on the iliac fossa, flexing, laterally rotating, and adducting the femur.

The hamstring group is comprised of semimembranosus, semitendinosus, and biceps femoris. As a group, they flex the knee, extend the hip, and tilt the pelvis posteriorly. Semimem-
branosus and semitendinosus also medially rotate the hip and the flexed knee. In contrast, biceps femoris laterally rotates the hip and the flexed knee.

The gluteals include gluteus maximus, medius, and minimus. Gluteus maximus is a hip extensor and also laterally rotates the femur, with the upper fibers abducting and the lower fibers adducting the hip. Gluteus medius is mainly an abductor of the hip, but it also assists in flexion and extension of the same joint. This muscle medially rotates the femur, stabilizes the pelvis when standing on one leg, and the posterior fibers may also laterally rotate the femur. Most people can be made aware of this muscle at the side of the upper hip in the standing leg when the other leg is lifted off the ground. Gluteus minimus is mainly an abductor of the hip but also assists in flexion and medial rotation.

The spinal extensors include two groups: Iliocostalis, longissimus, and spinalis, know collectively as the erector spinae, bilaterally extend the spine. The transverso spinalis muscles lie deep the erector spinae and also bilaterally extend the spine. This group includes semispinalis, multifidus, rotatores, interspinales, and intertransversarii.

The client, Christine, is a 39 year old female complaining of low back cramping, continual pain in the upper back and traps, and tension in the posterior neck. A regular hunched seated posture and twisting to the right due to her work seem to contribute to pain points. Standing on
one leg or the other is also a habitual posture for this client, which is sometimes identified as a contributing factor to FP. She is also a ballet dancer and thus has extreme lateral rotation of the hip and tends towards the long hip flexors required for poses such as arabesque.

Christine spends 4-6 hours a week dancing and working on related stretching, cycles in intense bursts of approximately four weeks in duration 3-4 times a year, and receives massage work on average once every two months. Massage provides temporary relief of minor acute complaints but does not create lasting change. She reports that cycling creates a feeling of tightness in the thighs and hip flexors, which she counteracts with a minimum of thrice-weekly sessions of hip flexor stretching.

Dance, and ballet in particular, overstresses extreme flexibility in the inner thigh and groin area and this, coupled with the balletic pelvic tuck and the need for strong lateral hip rotators, needs to be counterbalanced with hip flexor and inner thigh work to create balanced strength in the client's full range of motion (ROM).

The right side of Christine’s torso tends to shorten, the inner thighs are weak, and her abdominal muscles are generally weak. Due to posterior neck tension, she requires neck support during sustained ab work, rollup assistance such as with the rollup bar, and she does not have the strength for supine rollovers of any kind. She is currently unable to sustain abdominal contraction, she is unable to hold or perform certain Pilates exercises, and she falls backward in dance turns and jumps with the shoulders over the heels and the pelvis pressing forward. She has little to no lumbar flexion and "jumps" over the low back in all exercises requiring spinal articulation, including Roll-Like-a-Ball and Pelvic Curl.

The following poses are currently contraindicated due to the client's unique pain patterns:
- Any sustained supine ab curls without assists/modifications, including full Hundreds
- Spinal rolling, rollovers, and unassisted (supine) rolldowns / rollups
- Inverted postures resting on the shoulder girdle

The goal has been to design a program that increases global, functional abdominal strength and control with a particular focus on the lower abs as well as increasing sustained contractions. Upper back extensors especially need to be strengthened in order to correct the thoracic kyphosis and the forward position of the head. Building a certain amount of hip flexor strength and creating hamstring length should help reposition the pelvis over the legs.

Abdominal exercises should be emphasized, using modifications and assists until the client is able to sustain a supine abdominal curl without support of the head and neck. It is important to stress the hip-to-rib connection, or C-curve, and maximize lumbar flexion where applicable in order to develop flexibility in the lumbar spine, as well as to encourage co-contraction of the abdominals and back extensors to provide trunk support and stability. Stressing neutral pelvis and overall abdominal strength is key, especially the lower abs and Transverse Abdominus (TA).

Focus should also include single leg work, particularly exercises from the Single Leg Supine Series on the Cadillac in order to integrate inner thigh work by keeping each leg to the midline. The client's legs tend to list to the left, and she finds it difficult to keep her legs centered. This is also apparent in dance work - her tendue devant and derriere tend to move laterally off the midline.

It is also recommended that Christine de-emphasize extensive hamstring strengthening, which would assist in maintaining the posterior tilt of the pelvis. Balance needs to be brought to the legs by strengthening the hip flexors and the front of the thighs. Improved strength in the quadricep group will help balance the strength of the hamstrings as well as encourage a more neutral position of the pelvis by drawing it away from its posteriorly tilted position. Greater to-
nicity in the psoas major muscle would encourage a return to a more normalized lumbar curve, while added strength in iliopsoas would also aid in the repositioning of the pelvis. Upper back extensor strength needs to be developed while at the same time teaching the lower spine to flex through stretching and mobilization of the deep, low back muscles.

**Current Program utilizing the BASI Block System**

**Roll Down**

**Basic Warm Up**

- Pelvic Curl - *ball or block needed to encourage inner thigh activation*
- Spine Twist Supine - *with and without Step Barrel*
- Chest Lift - *with and without Step Barrel*
- Chest Lift with Rotation
- Leg Lifts / Leg Changes

**Footwork**

- Reformer footwork, including Prehensile - *emphasize proper positioning of the feet throughout*

**Abdominals** - *focus on building abdominal strength with little to no sustained abdominal contraction*

- Hundred Prep (Reformer)
- Coordination *(limited sustain)*

**Hip Work** - *hip adductor activation and strength*

- Frog
- Down Circles
- Up Circles
- Openings
Stretches

Gluteals or Standing Lunge

Arm Work

Arms Supine Series - lats and serratus for shoulder stability

Extension
Adduction
Up Circles
Down Circles
Triceps

Lateral Flexion / Rotation - oblique activation/strength and trunk stability with head/neck relaxed

Side Lifts

Back Extension

Back Extension

Roll Down

Future Program utilizing the BASI Block System

Roll Down

Intermediate Warmup - continue to use Pelvic Curl to encourage adductor activation and spinal articulation with attention to full flexion of the lumbar; alternate with Cadillac warmup

Roll-Up - using RUB; work towards unsupported Roll-Up

Spine Twist Supine - use modification(s) for added challenge

Double Leg Stretch - support the head and neck with the hands; keep legs above 45 degrees

Single Leg Stretch - support the head and neck with the hands

Criss Cross
-or- **Cadillac Warm Up** - trunk, pelvic, and shoulder stabilization; abdominal strength/control

  Roll-Up with RUB

  Mini Roll-Ups

  Mini Roll-Ups Oblique

  Roll-Up Top Loaded

**Footwork** - co-contraction of abdominal and back extensor muscles as well as pelvic floor activation

  Wunda Chair footwork

**Abdominals** - build abdominal strength/control without the attendant supine neck pain/tension; lumbar flexion

  Standing Pike

  Pike Sitting

**Hip Work** - hip adductor activation, strength, and control with pelvic stabilization

  Down Circles

  Up Circles

  Extended Frog

  Extended Frog Reverse

**Spinal Articulation** - supported abdominal strength with relaxed head/neck; lumbar flexion; hamstring stretch

  Short Spine

**Stretches**

  Gluteals or Standing / Kneeling Lunge

**Full Body Integration I** - 1-2 exercises; alternate by session

  Up Stretch 1 and/or Elephant - abdominal and back extensor strength/control; hamstring stretch

  Stomach Massage - work into series to focus on abdominal and back extensor strength

  Down Stretch
Arm Work

Arms Sitting Series - *further encourage co-contraction of the abdominals and back extensors; pelvic floor lift; shoulder strength and stability*
   - Chest Expansion
   - Biceps
   - Rhomboids
   - Hug-A-Tree
   - Salute

Leg Work - *balancing inner and outer thigh work*

   - Single Leg Skating
   - Side Splits

Lateral Flexion / Rotation

   - Side Over Box - *down hand on headrest for support; work up to both hands behind head*

Back Extension - *alternate exercises by session for back extensor strength*

   - Pulling Straps 1 - *shoulder and back extensor strength*

   (Pulling Straps 2)

   - Breaststroke Prep - *work towards Breaststroke*

   - Swan Basic - *work towards Swan on Floor*

Roll Down

The main problem of FP is the out-of-balance curvature in the spine created by poor posture and biomechanics. The strength of the upper back extensors must be addressed to bring the head, neck, and shoulder girdle back into proper alignment and normalize the curvature in the cervical and thoracic spines. In addition, the lack of flexion in the lumbar spine as well as the
posterior pelvic tilt and the hyperextended hips need to be corrected. Additional strength in the hip flexors, primarily iliopsoas, is needed, as is general abdominal strength, and a return to balance between the front and back of the thighs, so the overly-strong hamstrings stop pulling the pelvis further into a posterior tilt.

A balanced Pilates program can address these issues when emphasis is placed on the above-stated areas. FP responds well to this program, as demonstrated by improvements Christine has made in a relatively short period of time. After four months of consistent work with the current program, she has reported the disappearance of lower back spasms and a reduction in middle and upper back pain. Pilates exercises are performed with greater strength and fluidity and in some cases with added spring tension for additional challenge. She reports a greater overall awareness of poor body mechanics and bad habits and how the are affecting her pain patterns. Overall, Pilates has improved her quality of life and her ability to perform her job and her leisure activities with greater facility.
Bibliography


