The Postural and Biomechanical Effects of High Heel Shoes: A Literature Review

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April 10, 2012

A Senior Research Project Submitted in Partial Requirement

for the Degree of Doctor of Chiropractic

ABSTRACT

Objective: The purpose of this literature is to provide an overview of literature concerning the postural and biomechanical effects that high heel shoes have on the musculoskeletal system. The implications of postural imbalances, the roles that muscles play in the maintenance of both ideal and imbalanced human posture and certain gait distortions that may occur. Prevention and treatment options are also discussed.

Data Collection: The resources utilized included indexed/referenced journal articles, text and reference books. Pubmed, Chiroweb, Chiroaccess and Mantis were databases used to find journal articles and publications related to the effects of posture on the musculoskeletal system and or the effects of high heel shoes on posture and musculoskeletal biomechanics.

Results: The keywords high heel shoes, high heeled posture, gait, posture, postural balance, lower crossed syndrome and spinal instability turned up various articles. The most relevant articles were chosen and included in this compilation.

Conclusion: An extensive body of literature supports a conclusion that faulty posture due to the wearing of high heels can have detrimental effects on the musculoskeletal system and its biomechanics. The means to evaluate and address faulty posture is crucial in the evaluation and treatment of the biomechanical stresses placed on the musculoskeletal system. Most women who wear high heels have at some point experienced the conditions associated with the faulty body biomechanics. Evidence supports postural involvement in low back pain, ankle and foot pain, knee pain and certain gait disturbances.

Key Indexing Terms: *posture, high heel shoes, high heeled posture, posture, postural imbalance, lower crossed syndrome*

INTRODUCTION

Since the 1500's high heel shoes have been one of the cornerstones of a woman's wardrobe. This footwear accentuates the wearer's calves and changes the wearer's posture and gait making her appear "more attractive". It is true that a beautiful pair of shoes can change a woman's attitude and silhouette. In fact, shoes are no more mere accessories of the feet, but the essential part of a woman's fashion that reflects her personality. As the high heel shoes have always been in fashion statements for women, you will find many women going crazy about them, ignoring the postural effects that the shoes can create.

Posture plays a vital role in the everyday life of people. The ability to maintain an ideal postural balance within the human body is of vital importance to healthy musculoskeletal functioning. When left untreated, postural imbalance can develop into musculoskeletal disorders that can affect the neuromusculoskeletal system. The prevalence of musculoskeletal medical disorders in the U.S. was estimated by the National Health Interview Survey (NHIS) to affect nearly 107.67 million adults, representing one out of every two people over the age of 18 in 2005. (3) Between the years of 2002 and 2004 the annual average total cost of musculoskeletal disorders in the U.S. was estimated at $849 billion. (4)

Posture as defined by the American Chiropractic Association is "The position in which we hold our bodies while standing, sitting, or lying down." Good posture is the correct alignment of body parts supported by the right amount of muscle tension against gravity. Without posture and the muscles that control it we would simply fall to the ground. Normally we do not consciously maintain normal posture. Instead certain muscles do it for us and we

don’t have to think about it. (6) Several muscle groups, including the hamstrings and large back muscles are critically important in maintaining good posture. While the ligaments help to hold the skeletal system together, these postural muscles, when functioning properly, prevent the forces of gravity from pushing us forward. Postural muscles also maintain our posture and balance during movement. (7)

Good posture helps us to stand, walk, sit and lie in positions that place the least strain on supporting muscles and ligaments during movement and weight bearing activities. Good posture helps us keep joints in correct alignment so that our muscles are used correctly, decreasing the abnormal wearing of joint surfaces that could result in degenerative arthritis and joint pain. It reduces stress on the ligaments holding the spinal joints together and it allows muscles to work efficiently. To maintain proper posture you need to have adequate muscle flexibility and strength, normal joint motion in the spine and other body regions, as well as efficient postural muscles that are balanced on both sides of the spine. (6)

Poor posture can lead to excessive strain on our postural muscles and ligaments and may even cause them to relax when held in certain positions for so long. Several factors contribute to poor posture most commonly, stress, obesity, pregnancy, weak postural muscles, abnormally tight muscles and high heeled shoes. Wearing high heel shoes can cause faulty posture leading to other problems that many women fail to realize. This poor posture over time can have drastic effects on your musculoskeletal system. (5)

DISCUSSION

Discussion will review relevant literature that evaluates the common biomechanical faults that high heel shoes cause including postural measurement, ideal alignment, postural muscles, change in center of gravity, pelvic tilt, muscular imbalances, low back pain, knee ankle and foot posture, and change in your gait and balance.

Postural Axes

Posture is the composite of the position of all the joints of the body at any given moment. Static postural alignment is described in terms of the positions of the various joints and body segments. (8) This paper describes muscle balance and imbalance associated with the static posture and the wearing of high heel shoes. It is important to start by explaining the different body postures and planes. The anatomical position of the body is an erect posture with face forward and arm to the side of the body with the hands and forearms in a supinated position and thumb extension. This is the position of reference for descriptions of the body planes and axes.

There are three basic planes of reference and are at a right angle to each other. (9) A sagittal plane is vertical and extends from front to back it divides the body into the right and left. The coronal plane is vertical and extends from side to side it divides the body into an anterior and posterior portion. A transverse plan is horizontal and divides the body into upper and lower portions. Axes are real or imaginary lines about which movement takes place. (10)There are three basic types of axes at right angles to each other. A sagittal axis lies in the sagittal plane and extends horizontally from front to back. A coronal axis lies in the coronal

plane and extends horizontally from side to side. A longitudinal axis extends vertically in a cranial-caudal direction.

Motion

There are different motions that occur in these planes; flexion and extension movement takes place in the sagittal plane. It is the body motion moving forward and back from the coronal plane. Flexion is the forward movement and extension is the backward movement. Abduction and adduction occurs in the frontal plane. It is the movement of the body from the sagittal plane. Abduction is the movement away from the sagittal plane and adduction is the movement toward the sagittal plane. Circumduction is the movement that combines flexion, abduction, extension and adduction in which the part being moved describes a cone. Rotation takes place along the longitudinal axis and about the transverse plane for all areas of the body except the scapula and clavicle.

Postural Measurement

Various machines are available for use in evaluating postural alignment. The complicated machines, however introduces variables that are difficult to control. Fortunately accurate postural examinations can be done with the human eye at no cost. A plumb line is used as a line of reference. Plumb line represents a standard. The plumb line test is used to determine whether the points of reference of the individual being tested are in the same alignment as the corresponding points in the standard posture. (12)

An ideal plumb line alignment from the side view should drop slightly posterior to apex of coronal suture, though external auditory meatus, through the odontoid process of axis,

midway through the shoulder, through bodies of the lumbar vertebrae, through sacral promontory, slightly posterior to center of hip joint, slightly anterior to axis of knee joint, slightly anterior to lateral malleolus and through calcaneocuboid joint.(8) An ideal plumb line from the back view should begin midway between the heels; it extends upward midway between the lower extremities, through the midline of the pelvis, spine, sternum and skull. (12)

Ideal Alignment

To be able to recognize the component of a misalignment, an observation and standards of the ideal alignment should be observed. Many authors have discusses the normal posture and ideal alignment.(13-17) The ideal and standard skeletal alignment involves a minimal amount of stress and strain and is conductive to maximal efficiency of the body. It is essential that the standard meet these requirements if the whole system of posture training that is built around it is to be sound. Human has the most economical mechanism once the upright posture is attained. The expenditure of muscular energy is actually very economical. (18)

In the standard position the spine presents the normal curves and the bones and the bones of the lower extremities are in ideal alignment for weight bearing. The chest and upper back are in a position that favors optimal function of the respiratory organs. The head is erect and is well balanced position that minimizes stress on the neck musculature. The ideal alignment of the head and neck is one in which the head is in a well-balanced position that is maintained with minimal muscular effort. In a forward head position the neck extensors are in a shortened position and are strong and the potential exist for development if adaptive shortening in these muscles. The anterior vertebral neck flexors are in an elongated position

and give evidence of weakness when tested for strength.

The neutral pelvic is one in which the anterior superior iliac spines are in the same horizontal plane and the anterior superior iliac spines and the symphysis pubis are in the same vertical plane. In addition the anterior superior iliac spines and the posterior superior iliac spin are approximately in the same plane. The muscles are attached to the pelvis of opposing groups have an equal mechanical advantage in the straight line pull. Neutral position of the pelvis there is a normal anterior curve in the low back. In anterior tilt of the pelvis there is a lordosis. In the posterior tilt of the pelvis there is a flat back. The hip and knee should be stable and not constantly moving in flexion and extension. However these joints cannot be stable and off center either if this exist it could be due to limitation of joint motion in one direction. (8)

Postural and Movement Muscles

Understanding the characteristics will help to understand the effects that high heel shoes will have in specific muscles. The skeletal muscles move the human structure through space. They exhibit an extraordinary dynamic range, capable of producing large burst of motion that propel the body against the force of gravity. The skeletal muscles also support the position of the bones in relation to each other against the force of gravity to maintain postural integrity. The muscles that are mostly responsible for movement are called phasic muscles. The support, or postural, muscles are known as tonic muscles and their role is very important in body posture.

The movement, or phasic, muscles are responsible for moving the body through space. These muscles are made up predominately of fast twitch red fibers, which contract and release

rapidly in response to stimulus. The movement muscles are linked to the body's many reflex arcs. They can move the body quickly to adapt to unanticipated events, like stepping off an unseen curb. The fast twitch fibers have a relatively low blood supply available to them, causing these fibers to fatigue quickly and produce large amounts of lactic acid that are not flushed out of the muscles quickly. Although the movement muscles have more short-tern strength than postural muscles, they tire much faster and need more recovery time.(19)

Postural muscles support the body against the force of gravity. They are referred to as the workhouse muscles because they have to be able to perform for long periods, sustaining a semicontracted state. Our main postural muscles consist of the following muscles: hip flexors (iliospoas, Sartorius, etc.), erector spinae muscles, gastrocnemius, hamstrings, piriformis, quadratus lumborum, rectus femoris, and soleus. These muscles are made up of a large percentage of slow-twitch red fibers, which have plentiful blood supply. These muscles maintain a high level of endurance because their fibers do not contract in unison but, rather segmentally. The motor units in the fibers fire irregularly. As one section of the muscle contracts other portions relax. Since the fibers contract in relay fashion, these muscles do not tire easily and therefore can offer long term support to the body. Not enough fibers contract at one time to produce movement of the bones, but they are able to maintain a continuously toned state that braces the structure against the force of gravity. The movement capabilities of these muscles are limited, as is their ability to sustain heavy loads. (7)

In a person with muscular imbalance, movement muscles tend to weaken in response to postural muscles shortening. Like postural muscles, movement muscles can also become hypertonic. The quick changes in length that are sometimes required of movement muscles to stabilize the body's equilibrium can lead to spasms and permanently contracted states. When

a person's posture is distorted, the postural muscles have to work very hard to brace misaligned joints and tend to become hypertonic. This permanent highly contracted state of muscles fosters the formation of trigger points. The body also produces additional connective tissue in these muscles to bolster their bracing capability. The overabundance of connective tissue confines the muscle in its contracted state, preventing it from being able to lengthen. Thus, the body becomes congealed into a distorted shape. Because of the unyielding nature of built-up connective tissue, the person cannot willfully move the body into the proper position. (20)

Postural Presentation

When standing in high-heeled shoes, posture changes so that the back is arched, the pelvis and chest are thrust forward, the buttocks sticks out, and the calf muscles tighten (1). When standing straight up without wearing heels, the body creates a 90 degree angle with the floor, which is a normal stance. If the body were a rigid column, putting on a pair of heels would force the entire body to tilt forward, and the angle made with the floor would decrease or, in other words, become acute. As heel height increases, this angle would decrease and give the body more slant. However, the body is not a rigid column, so in order to wear high-heels and maintain a normal stance, a series of joint adjustments is required (5). The body's adjustment to this change in angle creates the classic, curved high-heeled stance.

Women presenting with anterior pelvic tilt, increased lordosis of the lumbar spine, knees slightly flexed with some knee varus, hypersupination of the foot, these postural findings could correlate to the following muscle imbalances: abdominal core muscles, gluteal

muscles, upper back erectors spinae are elongated and weak. Hamstrings are slightly elongated but may or may not be weak. Hip flexors and lower back muscles are shortened and strong. (20)

Pelvic Alignment

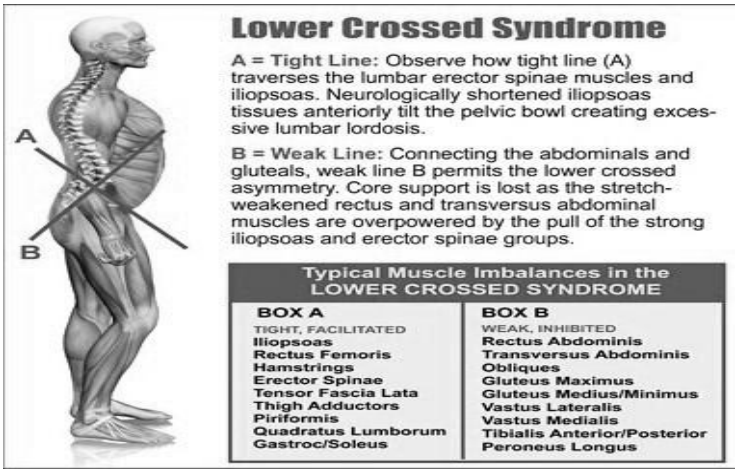
Lordosis is a medical term used to describe an inward curvature of a portion of the lumbar and cervical vertebral column.(21) Two segments of the vertebral column, namely cervical and lumbar, are normally lordotic, that is, they are set in a curve that has its convexity anteriorly and concavity posteriorly in the context of human anatomy. When referring to the anatomy of other mammals, the direction of the curve is termed ventral. Excessive or hyperlordosis is commonly referred to as swayback or saddle back. (22) A major factor of lordosis is anterior pelvic tilt, when the pelvis tips forward when resting on top of the femurs. If the pelvis rotates forward as a result of some kind of condition, the center of gravity of the body will move forward as well. The upper torso will then move backward to reposition the center of gravity so that it is vertically balanced. (21)

Sway Back Posture

An excessive front-to-back lumbar curve is the end result given other names such as Hyperlordosis, Swayback, or Saddleback. This Postural Dysfunction of the lower back Lumbar Spine causes muscular imbalances as well as incorrect lumbar spine positioning. Hyperlordosis doesn't happen overnight, but develops over a period of time, and is fundamentally a postural and developmental problem. Lordosis occurs when the heels of the feet are lifted higher than the balls of the feet. Lordosis is caused by wearing high heeled

shoes, which results in postural dysfunction of the lower back. That postural dysfunction then causes muscular imbalances that occur where there are weak and inhibited muscle groups in opposition to corresponding anterior and posterior hypertonic muscle groups in the pelvis and lower torso. (22)

This results in Lower Crossed Syndrome, a common muscular imbalanced condition of the lower torso. The anterior hypertonic muscle groups directly related to Hyperlordosis Lower Crossed Syndrome are the Hip Flexors (Psoas Muscles) and the upper anterior thigh muscles (Rectus Femoris and Sartorius). The posterior hypertonic muscle groups directly related to Hyperlordosis Lower Crossed Syndrome are the muscles of the Lumbar Spine (Erector Spinae, Multifidi, Quadratus Lumborum, Rotatores). The anterior weak and inhibited muscle group directly related to hyperlordosis is the abdominal Muscles (Rectus Abdominus). The posterior weak and inhibited muscle groups directly related to lordosis is the buttocks muscles (Gluteus Maximus) and the posterior upper leg muscles also known as the Hamstrings or Biceps Femoris. (see figure 1)



(Figure 1)

With the spine positioned in an excessive lordotic curve, a primary dysfunctional source of pain and a secondary dysfunctional source of pain is created. The primary source of pain is the improperly positioned lumbar spine. The secondary source of pain is the abnormal tissue hypertonicity that is created. The improperly positioned lumbar spine due to hyperlordosis results in unbalanced, uneven, and abnormal weight bearing loads upon the lumbar vertebrae and the intervertebral discs, which could result in nerve impingement and/or sciatica. The excessive curve also results in incorrect lumbar facet joint movement i.e. reduced lumbar facet joint movement and /or lumbar facet joint compression which can turn into lumbar facet syndrome. Facet Syndrome could be a stuck open or closed facet joint or a facet joint that sticks or binds. This could also cause Facet Arthritis. Facet Syndrome Pain Symptoms due to the improperly hyperextended lumbar spine are the result of Facet Joint Compression, decreased facet joint movement, and irritation caused within the limited facet range of motion in a hyperextended state. (22)

Hips

The hip flexor muscles are located on the upper front part of your thighs. The iliopsoas is the chief flexor of the thigh, the most powerful of the hip flexors with the longest range. Although it is one of the body's most powerful muscles, it is relatively hidden, with most of its mass located in the posterior wall of the abdomen and greater pelvis. Its broad lateral part is the iliacus, and its long medial part, the iliacus, and its long medial part, the psoas major, arise from the iliac fossa and lumbar vertebrae, respectively. Concentric contraction of the iliopsoas typically moves the free limb, producing flexion of the hip to lift the limb and initiate its forward swing during walking. (7)

The iliopsoas is active during standing in maintaining normal lumbar lordosis and resisting hyperextension of the hip joint. The Sartorius muscle and quadriceps femoris muscles are also apart of the anterior thigh muscles that flex the hip joint. They are forced to work much harder and longer to help you walk because your feet are held in a downward position and have reduced power to move your body forward. If your hip flexor muscles are chronically overused, the muscles can shorten and a contracture can occur. This contracture can further cause the lower cross syndrome to occur. Tight hip flexors and weak glutes create a posture that also shifts more weight to the front of your foot which in turn overloads the calf and creates the lower leg issue. This imbalance causes greater stress on the foot and ankle, Achilles tendon, knees, hips and low back. (23)

Knee Posture

A good alignment consists of the patellae facing directly forward with the feet neither pronated nor supinated. The deviation from the norm as a result of high heel shoes could present as the following: supination of the feet which is suggested by high arches, bearing of weight on the outside of the feet.(29) This posture could point strain on the longitudinal arches. Knees could also present with a moderate flexion which requires a constant flexion of the quadriceps muscles. This could be a result of hip flexor tightness due to the wearing of high heel shoes. With hip muscle tightness there is a compensatory alignment of the knees or the low back or both. The muscles of the anterior thigh that are involved in extending the knee include the following: quadriceps femoris, rectus femoris, vastus medialis, vastus lateralis, and vastud intermedius. (24)

It has been proposed that high-heeled shoes may contribute to the development and progression of knee pain ultimately resulting in osteoarthritis. Patellofemoral pain syndrome and osteoarthritis of the knee are common musculoskeletal conditions .Both patellofemoral syndrome and osteoarthritis knee are more prevalent in females than males (24-26) Although the pathomechanics of these pathologies may differ, it is believed that muscle dysfunction is a contributing factor in both. In particular, the proposed imbalance between the quadriceps muscles vastus medialis and vastus lateralis is believed to be important, and this has been investigated in patients with Patel femoral(24) and also osteoarthritis of the knee.In a recent survey the American Podiatric Medical Association ascertained that 62% of American women wear heels over two inches in height regularly and that these are considered high heels. As this is a possible risk factor that may contribute to knee pathologies in women, and one that can be modified, it warrants attention. (2)

High heels have been shown to elicit greater activity in rectus femoris, and cause larger vertical and anterior-posterior ground reaction forces during gait (22), and also to increase erector spinae and tibialis anterior EMG activity (23). In addition, it has been reported that high-heeled shoes increase the external adduction moment at the knee joint (19), implying an increased medial compartment load. This may affect muscle activity around the knee joint, and theoretically could manifest as either an increase in vastus medialis activity, or a reduction in vastus medialis activity from inhibitory mechanisms elicited by altered biomechanical forces at the knee joint. Knee osteoarthritis is twice as common in women. Some of that blame may be due to high heels. The knee stays flexed and the tibia turns inward causing knee varus when wearing high heels.(30) This position puts a compressive force on the inside of the knee (medial), a common site of osteoarthritis. If you already have

osteoarthritis, it is best to avoid wearing high heel shoes. High heels increase the distance from the floor to the knee and can result in increased knee torque which can also lead to osteoarthritis.(23.25)

Ankle and Foot Posture

In normal function and anatomical position, the ankle joint has flexion known as dorsiflexion and extension known as plantar flexion. All other movements in the ankle region are created by the foot's dynamic joint structure. The ankle is composed of the distal tibia, distal fibula and dome of the talus (also known as the ankle mortise or mortise joint). The foot is composed of 26 bones and 33 joints and has many intrinsic and extrinsic muscles. Although inversion and eversion are actions not of the ankle joint but of the foot, the musculature within the lower leg acts directly on the foot and needs no assistance from other muscles to create motion. Pronation and supination occur not in the foot but in its subtalar joint.(28) The ankle joint is constantly exposed to extreme mechanical conditions during even the simplest motion, such as gait. A hinge joint with only the ability to create flexion and extension freely in the sagittal plane, the ankle (tibiotarsal joint) controls movement of the leg relative to the foot. These movements are essential for walking on any surface, regardless of terrain. (31)

The ankle is subject to the weight of the entire body and the forces generated by the dissipation of kinetic energy when the foot makes contact with the ground. Dorsiflexion is the lifting of the dorsum of the foot toward the anterior surface of the leg. Range of motion is zero to 20 degrees. The muscles involved in dorsiflexion include the following: tibialis anterior, extensor digitorum longus, and extensor hallicus longus.Extension, or plantar flexion, of the ankle occurs when the dorsum of the foot lengthens in line with the leg, or points downward .

Plantar flexion angle is much greater than that of dorsiflexion; ROM is zero to 50 degrees. The muscles involved in plantar flexion includes the following: Gastrocnemius, soleus, plantaris, flexor hallicus longus, flexor digitorum longus, tibialis posterior, peroneus longus and peroneus brevis. Our feet not only take on the difficult, demanding function of bearing body weight but also perform complex movements necessary for walking, running and jumping. Malfunction and malformation of the feet are common in women who wear fashionable high-heels (26)

Shin splints can also be developed by the wearing of high heel shoes.Typically shin splints are an overuse injury to the tibialis anterior muscle, the muscle in the front of the lower leg that dorsiflexes your ankle . The overuse is typically not caused by too much running but by a muscle imbalance that forces the anterior tibialis to work extra hard against calf muscles that are over tight or over developed in relation to the anterior tibialis as in wearing heels. During the push-off phase of your walking gait the calf contracts, your foot points downward and you go forward. It’s the job of your anterior tibialis to control and decelerate that movement, if your anterior tibialis isn’t strong enough, it or its connective tissues becomes stressed and sore.

With the foot in a downward position as in wearing high heels, there is significant increase in the pressure on the forefoot. The pressure increases as the height of the shoe heel increases. Wearing a 3 1/4 inch heel increases the pressure on the bottom of the forefoot by 76%. The increased pressure may lead to pain or foot deformities such as hammer toes, bunions, bunionettes (tailor's bunions) and neuromas. The downward foot position also causes the foot to be more supinated. This change in foot position changes the line of pull of the achilles tendon and may cause a condition called Haglund's deformity also known as pump

bump. Wearing high heels places the calf muscles in a shortened position. As muscles and tendons are highly malleable tissues, chronic use of high heels might induce structural and functional changes.(29)

High heels limit the motion and power of the ankle joint.The calf muscles (gastrocnemius & soleus) are shortened because of the heel height. The shortened muscles cause them to lose power when trying to push the foot off of the ground (32). The position of the ankle may also cause a shortening of the Achilles tendon(26). This can increase the pull of the achilles tendon where it attaches on the back of your calcaneus and may cause a condition called insertional achilles tendonitis. As adequate levels of tension within the muscles and tendons are required for both effective force transmission to the skeleton and proprioception, the plantarflexor muscles might acutely react by increasing their tonic activity to take up the excessive tendon slack. A shortened gastrocnemius and soleus and increased Achilles tendon stiffness in habitual high heel wearers reduce the ankle active range of motion and thus explain the discomfort these women experience when walking in flat shoes(23).

Gait

Gait kinematics is adversely affected when wearing high-heeled shoes, most particularly at the ankle joint. The changes in gait from high heels leads to excessive plantar flexion an increased metabolic cost when walking and an accelerated muscle fatigue which overall can affect your foot stability and may lead to ankle sprains and falls. Usually during gait the leg muscles of tibialis anterior and extensor hallucis longus tend to contract immediately after initial contact with the ground and again towards toe-off (2). These muscles

also assist with ankle stabilization and arch support. The other leg muscle used during gait is that of peroneus longus which acts to stabilize the ankle from mid-stance to push off. When walking, your foot is in a more fixed in a plantar flexed position therefore you are not able to push off the ground with as much force. This causes your hip flexor muscles in your legs to work harder to move and pull your body forward. Your knees also stay flexed and forward, causing your knee muscles to work harder. (31)

The activity of the muscles which dorsiflex and evert the foot (fibularis longus and brevis) help stabilize the body over the center of pressure medially while the muscles of the leg which aid in planter flexion and inversion of the foot (tibialis anterior) help move the center of pressure laterally.(29) The action of the evertor and invertor foot muscles help aid in creating ones balance. With high heels the width of the foot ends up getting smashed width wise which in turn changes the foots center of pressure in keeping one balanced. This imbalance results in poor foot-ground interaction during stance phase and may lead to an inversion motion of the foot resulting in ankle sprains and or falls.(28) In addition another problem which affects ones foot and leg muscles while wearing high-heels is that of muscle fatigue which can also lead to the inability of the foot to control ones balance and may lead to a probable injury.

When walking in high-heeled shoes, a significant reduction in ankle plantar flexor muscle moment, power, and work occurred during the stance phase, whereas increased work was performed by the hip flexor muscles during the transition from stance to swing. In the frontal plane, increased hip and knee varus moments are present.(12,23)These differences demonstrate that walking in high-heeled shoes alters lower-extremity joint kinetic function.

Reduced effectiveness of the ankle plantar flexors during late stance results in a compensatory enhanced hip flexor "pull-off" that assists in limb advancement during the stance-to-swing transition. Larger muscle moments and increased work occur at the hip and knee, which may predispose long-term wearers of high-heeled shoes to musculoskeletal pain.(29)

Prevention and Treatment

Although high heel shoes cause certain distortions on the body most women are unopposed to stop wearing them. High heel shoes tend to define a woman's persona and since a pair of high heel shoes has style factors attached to it, woman have a hard time separating it from their total grooming. There are certain things that a woman can do to minimize the adverse effects of high heels. Wear heels less or save your heels for the weekends or evenings of going out. Women who continue to wear high heels should consider wearing shorter heels. Wearing high heels no taller than two inches will minimize ones changes in posture. Massaging the feet at the end of the day by placing a golf ball under the foot and rolling it around with different levels of pressure for one to two minutes is also advised. Stretching the calf muscles and Achilles tendon daily will help in releasing tension on the calf and Achilles tendon. In addition to your calf stretches work on mobilizing your ankle joints and strengthening the tibialis anterior.(5)Women will also benefit from making sure that their routine includes exercises that address hip mobility and gluteal strengthening. A good pair of custom shoe inserts that support all three arches of the foot in addition to the heel can provide much needed balance, posture and comfort for the entire body. (2)

CONCLUSION

Posture is both cause and effect in musculoskeletal health, reflecting the overall level of function of muscles and joints. The inability to maintain healthy posture as in the wearing of high heels is an important factor in the etiology of common musculoskeletal conditions in women such as low back pain, knee pain, and dysfunctional movement patterns. Postural imbalances which cause biomechanical effects on the body exert dysfunctional stresses on the muscles, ligaments, tendons and joints resulting in increased wear and tear on these structures over time. Over time there are negative consequences from wearing high heels. Some of the consequences of wearing high heels may include sprained ankles, lower back pain due to increased spinal curvature, leg pain due to added weight placed on the toes, shortened Achilles tendon, decreased stride and other changes to gait and mobility, and even the tendency of osteoarthritis in the knees. While wearing high heels one walks with more of an upward displacement in their bodies center of mass leading to a more unstable posture placing increased compressive force in ones low back increasing the activity of the erector spinae to maintain posture which may lead to low back pain. Fortunately the factors of high heel shoes that effect posture and musculoskeletal biomechanics are completely within one's ability to control and are not difficult to change. A postural evaluation performed by a chiropractor can evaluate how much the stress from wearing high heels is affecting the musculoskeletal system. Chiropractors are trained in adjusting the musculoskeletal system including joint dysfunction in the feet, ankles and knees as well.

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