

Heel Lift Protocols, Their Assessment and Application in the Chiropractic Practice

A Literature Review

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A senior research project submitted in partial requirement for the degree Doctor of Chiropractic

March 14, 2010

Abstract

Objective

This paper provides an overview of literature about the efficacy of using heel lifts as treatment for a variety of conditions, as well as summaries of the most prominent protocols utilized by chiropractors when prescribing lifts. Emphasis is placed upon conditions that may benefit from the proper application of heel lifts and the research supporting those heel lift treatments.

Data Collection

A computer search using PubMed and EBSCOhost generated articles relevant to leg length inequality, heel lifts, scoliosis, back pain and hemiparesis. Referenced sources were identified from the individual searches and from accumulated review of chiropractic literature.

Data Synthesis

The uses of heel lifts vary widely, but an understanding of the biomechanics of the body, particularly the relationship between the lower extremities, pelvis and spine, are critical to rationalization of the various protocols and appropriate implementation during treatment.

Conclusions

Heel lifts, when properly utilized, can have a significant impact on the quality of life of many patients. Strong evidence exists supporting the use of heel lifts to treat a variety of conditions, particularly low back pain and scoliosis when caused by a leg length deficiency.

However, more research is necessary to provide evidence-based support for the theories upon which various treatment protocols are based. Currently, there is no consensus as to the proper application of heel lifts, and clinicians must choose the one most appropriate for their patient's condition or the one that integrates most effectively with the rest of the patient's treatment plan. The biomechanics of the human body are complex, and patient lifestyles vary widely, thus the impact of lift therapy cannot always be pre-determined. Careful monitoring must be performed to ensure that the lift is having the appropriate therapeutic effect. In some cases, heel lifts can be used to correct a problem, while in others they can support therapies such as manual adjusting. In yet other cases, they are a permanent therapy to compensate for an otherwise untreatable anomaly. Regardless of the cause, when properly utilized, heel lifts can be a powerful adjunct to current therapies and a worthwhile tool about which clinicians should become educated.

Key Indexing Terms

"heel lift", "heel lift protocols", "chiropractic heel lift", "heel lift & back pain", "heel lift contraindications", "back pain", "leg length", "shoe lift", "scoliosis"

Introduction

A heel lift is a wedge shaped shoe insert that is used to elevate one foot in order to accommodate for a symptomatic anatomic leg length inequality or to treat a variety of other conditions such as low back pain or scoliosis. Unlike heel pads which are used for shock absorption, heel lifts are made of a firm, non-compressible material that allows for exact and constant addition of height to one leg. (See Appendix Table A-1 for comparison of various lifts.) Chiropractic physicians, as well as osteopaths and podiatrists, have utilized heel lifts for years, but there has been little consensus as to when they are appropriate and how they should be best utilized. This paper will consider the various uses for heel lifts, assess research supporting their use, and describe some of the most common chiropractic protocols used in fitting a patient for a lift.

There are numerous articles supporting the use of heel lifts to treat or prevent a variety of symptomatic conditions including: low back pain, achilles tendon injuries, chronic psoas syndrome, hemiparesis, scoliosis, sciatic pain, knee pain, hip pain, post stroke rehabilitation and gait correction. The most compelling research is that supporting the use of heel lifts in treating chronic low back pain. The National Institute of Health estimates that Americans spend over \$50 billion per year on back pain, making it the second most common neurological problem in the U.S., second to headache.¹ While the etiology of back pain can be elusive, there is evidence that pelvic obliquity from leg length inequality or other causes may be responsible in some cases.^{2,3,4,5}

From a clinical rather than symptomatic standpoint, Dr. Fred Barge suggests the following eight major reasons for prescribing heel lifts:

1. *To compensate for an inferiority and avoid unwanted spinal adaption. (scoliosis)*
2. *To reduce an inferiority that has initiated a scoliosis.*
3. *To support a rotary scoliosis and inhibit further rotatory degradation.*
4. *To reduce vertebral rotation.*
5. *To reduce a disc wedge or wedges.*
6. *To stabilize the adjustic correction of a vertebral subluxation.*
7. *To improve overall spinal balance.*
8. *To force spinal change.*⁶

Normally, the 5th lumbar vertebra hangs from its facets, which are the weight-bearing structures of the lumbar spine, balancing on the nucleus pulposus of the disc between the vertebra and the base of the sacrum. When the sacrum is unlevel due to a pelvic rotation, a short leg, a structural anomaly or other biomechanical changes, one side of the 5th lumbar vertebra will be lower than the other. This can cause a shift in the nucleus pulposus, creating an open wedge, generally on the low side of the sacrum. Through the body's righting reflex, curvatures will begin to develop in order to maintain an erect posture. When the foundation of the spine is unlevel, the famous H.B. Logan principle comes into play, "the body of the lowest freely movable vertebra always rotates toward the low side of the sacrum or the foundation upon which it rests."⁷ It is upon this theory that the majority of chiropractors utilize heel lifts to treat any number of conditions.

Discussion

Leg Length Inequality

The most common use of a heel lift is to equalize leg length in patients with an anatomic short leg, particularly when this occurs with a scoliosis of the spine and/or low back pain. The theory behind this use, as stated above, relies on the idea that the pelvis is the foundation of the spine, and if it is unlevel, it will cause compensations throughout the kinematic chain. These compensations may appear as scoliotic curves^{8,6} in the spine, hyperlordosis, hypolordosis,⁹ disc herniation,¹⁰ or other musculoskeletal pain syndromes. As the pelvis rests equally on each of the lower extremities, an imbalance in their length could cause an unleveling of the pelvis.¹¹

There are several methods of determining leg length and much controversy as to the reliability of these methods; however, radiologic measurement is generally considered the gold standard, with research supporting it as the most reliable and accurate method¹². Other methods include placing hands at level of iliac crests and visually comparing, comparing medial malleoli bilaterally, measuring with a tape measure from ASIS to medial malleoli, and placing a leveling device on the iliac crests while inserting wedges under the patient's heel until the crests are level. Most of these manual techniques of measuring leg length are considered a highly inaccurate way of determining actual leg length discrepancy but may provide useful information when utilized in conjunction with other data obtained from a physical examination. There is some research supporting the accuracy of tape measure analysis when compared with radiographically derived measurements, particularly when measurement is performed twice by an experienced clinician with the results averaged together.¹³ However, the results of this research show this method to be less accurate in healthy patients.

Once a reliable method of measuring leg length has been determined, the next question is just how much of a discrepancy is clinically significant. This topic is highly researched and debated, with no consensus yet reached.^{14,15,16,17} The reason for this may be due to the complex interrelationship between anatomical structures in the body and the ability of the individual patient's pelvis and spine to compensate for the inequality, as well as the activities performed regularly by the patient and the amount of mechanical loading his or her body takes on a regular basis. Thus, two patients with the same leg length discrepancy may present with widely differing symptoms ranging from a complete lack of symptoms to a severe debilitating condition. As a result, it may be relevant to consider the impact of a leg length inequality in a symptomatic patient; however, the information is essentially useless when used as a screening tool. While the research seems to show little reliability in determining the point at which leg length inequality becomes clinically significant, there does exist a measureable relationship between an inequality and the clinical consequences.¹⁸

A variety of studies have been performed that, depending on the variables selected, support or deny the relationship between a minor leg length discrepancy and clinical symptoms.^{19,20,21,22} However, perhaps the most important factor is simply the patient's response to care. If a patient reports reduction in symptoms following the use of a heel lift, then the heel lift should be considered clinically indicated. Leach²³ cites the following list of clinical criteria developed by Sandoz²⁴ which must be met in order to prescribe the use of heel lifts:

- *When a lift test shows palpatory and visual evidence for improved static posture on lifting the short leg and worsening on lifting the long leg. (A 1- to 1.5-cm-thick board is first placed under the foot on the side of the suspected short leg, then under the contralateral foot.) The patient is not told beforehand what the doctor suspects. Only when static and visual inspection confirm the blinded patient's subjective impression that lifting the short leg feels better than lifting the long leg, should prescription of a shoe lift be considered.*
- *When radiographs or visual inspection of the lumbar spine (standing and lying prone) reveal straightening in the non-weight-bearing position. The lumbar spine must be supple for adaptation to occur.*
- *When the inclination of all vertebral plates and the sacral base conform to the same radius of incurvation. Hence only when the short-leg side is the side of inferior sacral base height and convexity of lumbar curvature is the prescription for heel lift correction made.*
- *Correction with heel lift is based on a lift close or equivalent to the measured deficiency at the sacral base in adolescents or young adults; it seldom exceeds 50% of the measured deficiency at the sacral base in adults (when >7mm, lifting is accomplished in two stages, for easier adaptation by the patient).²⁵*

Low Back Pain

As stated earlier, the etiologies of low back pain can be widely varied and often elusive, yet it is one of the most common neurological disorders in the U.S.²⁶ There is evidence that

some types of low back pain may be the result of a leg length inequality and thus be treatable through the use of a heel lift.^{27,28,29, 30, 31, 32} A study, published in the Journal of Rheumatology, found that of patients with a leg length disparity and chronic low back pain who were treated with a heel lift, a significant number had major or total relief of their symptoms from this single treatment.³³ Yet another study, conducted in the Department of Physical Therapy at Tel-Aviv University in Israel looked at the use of shoe inserts in patients with chronic low back pain and a leg deficiency of 10mm or less. They found that shoe inserts significantly reduced pain intensity and disability and suggested that they are a simple, noninvasive and inexpensive therapy for chronic low back pain.³⁴

A more complex, randomized control trial was performed to assess the validity of using heel lifts to correct pelvic obliquity in patients with chronic low back pain. This group utilized postural radiographs to determine the amount of pelvic obliquity, along with objective pain and physical/emotional questionnaires. Custom shoe inserts were created for the experimental subjects, while off the shelf inserts were provided to the control group. Their findings showed significant improvement in general health, physical and social functioning, and vitality, and significantly less pain when compared with the control group.³⁵

Another study looked at leg length inequality and its relationship to the side of radiating pain in patients with herniated lumbar discs. Their findings showed a statistically significant association between leg length discrepancy and the side of radiating pain.³⁶

There has been little research conducted to ascertain the manner in which a leg length inequality can cause low back pain, or why heel lifts can help alleviate low back pain in certain

patients. Yet there are many chiropractic theories, founded on clinical experience and case studies, which suggest ways in which this may occur. Many of these theories are based upon the concept that a short leg causes an unleveling of the pelvis, and when the foundation on which the spine rests is unlevel, the spine must compensate in ways such as creating inferiorities, scoliosis, vertebral rotation or disc wedging.³⁷

Heel lifts may also be used to treat low back pain when there is no leg length discrepancy. While this may sound counterintuitive, many techniques incorporate the use of temporary heel lifts to further assist the corrective function of manual adjustments.^{38,39,40} The success of this application may be founded on several principles. One of these principles is that the addition of a lift on one side of the body induces an increase in pressure on the nucleus pulposus within the discs on the same side. This would cause a drift of the nucleus pulposus toward the opposite side. If there were an open wedge on the side of lift application, this could help to close that wedge and normalize the disc space.⁴¹

Another principle may be related to the effect of muscle balancing on the spinal system. One study investigated the effects of lift therapy via postural loading electromyography (EMG).⁴² This study found that the application of heel lifts caused balancing of paraspinal musculature in 51% of the subjects studied. (When the use of ischial lifts was included, this number jumped to 80% of subjects.) Another study investigated the timing of gluteus medius and erector spinae muscles during the gait cycle, with and without heel lifts and lateral forefoot wedging.⁴³ This study concluded that both heel lifts and forefoot wedging could produce

measurable (via EMG) changes in timing of muscle activity in the low back and pelvis throughout the gait cycle.

Scoliosis

The causes of scoliosis vary and are not fully understood but may include processes such as an unleveling of the pelvis (by any etiology), muscle imbalances, interruption of the creation of the normal curves of the spine in infancy and childhood, and spinal adaptations to uncorrected spinal subluxations. Often the initiating cause of scoliosis in a patient cannot be directly determined, and treatment is performed without knowledge of the exact underlying cause.

A study conducted at Palmer College of Chiropractic measured leg length radiographically in 106 patients and found that over half of the patients with leg length inequalities over 6 mm had some form of spinal adaptation.⁴⁴ While there was no particular association between leg length inequality and a particular spinal adaptation, over half of the patients with an inequality had at least one of the following: scoliosis, hyperlordosis or hypolordosis.

Research conducted at the University of Montreal looked at postural adaptations induced by a shoe lift in idiopathic scoliosis patients and concluded that a shoe lift does indeed affect the spine and the three-dimensional position and orientation of the pelvis and shoulder girdle.⁴⁵ This suggests that the proper application of lifts within the treatment of scoliosis may aid in the correction of those spinal curvatures.

One study actually investigated directly the use of heel lifts to reduce lumbar scoliosis. Founded on the theory that an unlevel sacrum may be a cause of lumbar scoliosis, they studied the use of a lift to level the sacrum. Their findings showed that use of a lift can indeed level the sacral base and reduce lumbar scoliosis.⁴⁶

Achilles Tendon Injury

Achilles tendon problems such as rupture or tendonitis are relatively common and frequently affect runners, dancers, walkers and tennis players. Often, part of the conservative treatment for tendonitis and post-surgical treatment for rupture includes the application of bilateral heel lifts.^{47,48} These lifts reduce the tension on the Achilles tendon during normal level walking^{49,50} without impacting patient mobility.

Hemiparesis Rehabilitation

Several studies have been performed assessing the use of heel lifts in the treatment of hemiparesis, usually following a stroke. The rationale behind this therapy rests on the concept that shifting the body's center of gravity toward the weaker side via insertion of a lift on the stronger side may induce greater rehabilitation. Several studies have been performed assessing symmetry of stance and postural control^{51,52,53} found improvement in each of these measures. An additional study⁵⁴ looked at hemiparetic patients utilizing a lift over a 6-week period and found improvement in walking speed, stride length and weightbearing.

Protocols

Leach⁵⁵ provides a useful and simplified chart, adapted from Panzer⁵⁶, (see Appendix Table A-2) which summarizes common distortions and related shoe lift applications. By the standards of some of the protocols, this chart is an over-simplification that does not take all possibilities into account. However, it may be a useful tool to a clinician considering the use of a lift in a specific patient.

*Logan Basic Technique*⁵⁷

Logan Basic Technique utilizes a rather complex set of rules for the application of heel lifts (as well as ischial lifts) that assesses leg length inequality, sacral unleveling, and wedging of the fifth lumbar body. Full spine x-rays are painstakingly measured and a series of calculations performed in order to determine which areas are involved and to what extent. Prior to utilizing heel or ischial lifts, a series of Basic pelvic adjustments are performed to attempt to normalize spinal function. If the patient's rotational pattern begins to normalize with these adjustments, then the use of any lift is likely counterindicated. Dr. Logan provided five rules which form the basis for heel and ischial lift application and upon which further determination for treatment may be based. Table 1 summarizes these rules.

Table 1 – Logan Basic Technique Rules for Heel Lift Application

Leg deficiency	Sacral inferiority	L5 Wedging	Application
Present	Absent	Absent	Heel lift on ipsilateral side
Absent	Present (ipsilateral)	Present (ipsilateral)	Equal heel lift and ischial lift on ipsilateral

			side
Present	Present (ipsilateral)	Present (ipsilateral)	Heel lift to compensate for all 3 findings Ischial lift to compensate for sacral inferiority and wedging only) – both ipsilateral
Present (and great enough to overshadow other two factors)	Present (contralateral)	Present (contralateral)	Heel lift ipsilateral Ischial lift contralateral
Present (but only enough to compensate for other two factors)	Present (contralateral)	Present (contralateral)	No heel lift Ischial lift contralateral

The actual amount of lift applied is determined by applying the “4:2:1 ratio” to the measurements generated from the full spine x-ray. The “4” refers to the amount of heel lift applied, the “2” refers to the amount of sacral lift this would create, and the “1” refers to the amount of L5 vertebra correction. Thus a 4 mm heel lift would raise the sacrum 2 mm and the L5 vertebra 1 mm on the same side as the lift. The theory behind this is based upon the idea that the further away the effective point (ie the heel lift) is from the point of rotation (midline of the body of L5) the greater the amount of lift is necessary to cause the desired change.

Gonstead Technique⁵⁸

Clarence Gonstead developed a protocol for the application of heel lifts to treat scoliosis, mainly in younger patients. There are four conditions within this system that must be met in order for the use of heel lifts to be appropriate. These conditions state:

1. *There must be a leg deficiency of greater than 6 mm.*

2. *A rotary scoliosis must be toward the side of the leg in question. That is the body rotation must be on the side of the short leg with the scoliosis towards that side.*
3. *There must not be any hip joint degeneration to a marked degree nor a knee problem on that side.*
4. *The patient should not be older than 35 years, ideally.*

When these conditions are met, a trial may be conducted. While never specifically providing a set of rules as to the actual measurements for the lift, it can be inferred from his comments that the height of the lift would ultimately be as much as the amount of leg deficiency present in the patient. It can also be inferred from his comments that Gonstead is referring to an actual leg length deficiency, as found and measured on x-ray. Gonstead states that as the change being created by the lift is permanent, the lift must be present in every pair of shoes worn by the patient. He also suggests that patients who frequently go barefoot are not candidates for heel lifts, as they are unable to wear a lift the majority of the time. Additionally, patients whose lumbar discs are very thin must be sure to wear the lift as much as possible.

When applying the lift, it is important to gradually build up to the full height. Gonstead states that the change should be made by adding a lift that is half the necessary height first, and gradually adding more lift. The addition of 7-9 mm at a time should not cause problems. When placing a lift into a man's shoe, up to 3/8 inches may be placed within the shoe itself. If a 1/2 inch or more is necessary, then the lift is placed on the outside of the shoe with half of the necessary lift placed on the sole of the shoe. Gonstead states that it is important not to reduce the opposite shoe but to build up the side of deficiency, as it would cause a "tired leg."

When applying a lift to patients who have the Gonstead listings, PIIN (posterior, inferior, internally rotated ileum) and ASEX (anterior, superior, externally rotated ileum) great care must be taken. A small amount of lift is applied, and then the patient is re-x-rayed 30-60 days later to determine if the lift has actually made the problem worse. Gonstead states that the upper cervical area would be the region of greatest compensation; however, the thoracolumbar junction may also show changes.

Reinert Specific Diversified Technique⁵⁹

The Reinert Specific Diversified protocol for the use of heel lifts is based upon the idea that pelvic unleveling from any cause can lead to spinal curvature, and that the use of properly applied heel lifts may reduce or prevent these curvatures. Additionally, lifts may be temporarily prescribed to “support and sustain the corrective effects of adjustments until healing processes are completed.”⁶⁰

Reinert highlights the importance of determining the actual cause of the pelvic unleveling prior to utilizing a heel lift. Causes such as a dropped foot arch or chronic knee flex should be treated directly, if possible, prior to implementing the use of a heel lift.

X-ray analysis is crucial to the determination of the need for and placement of a heel lift. Evidence of pelvic deficiency, along with the behavior of the lowest freely moveable vertebrae (most commonly L5) and the resultant curvature, provide the basis for the proper placement of the lift. The foundation for the theory is that the application of a heel lift on the side of an open

wedge will increase the pressure on the nucleus pulposus on the ipsilateral side, causing it to shift toward the contralateral side, thus reducing the open wedge. A cautionary note is included which states that without proper adjusting to the base of the lumbar sectional towering, application of a heel lift may increase the towering rather than reduce it.

The following rules guide placement of heel lifts within the Reinert system:

1. *Always use a lift under the side of pelvic deficiency if there is increased intervertebral space at the level of the lowermost movable vertebral joint on the side of deficiency.*
2. *Tentatively, use a lift under the side of pelvic deficiency if the intervertebral space at the lowermost movable vertebral joint is bilaterally equal, subsequently rechecking and removing lift if the space becomes less on the side of lift.*
3. *Never use a lift under the side of pelvic deficiency if the intervertebral space at the lowermost movable joint is less on the side of deficiency.*
4. *In conditions of lumbosacral anomaly, a shift of the nucleus pulposus and thickening of the annulus may compensate for the deficiency, permitting the lowermost movable vertebra to rest in a level attitude. There is no need of lift even though there is pelvic deficiency.⁶¹*

It should be noted that with an actual leg length deficiency, Reinert suggests that no more than 7-9 mm should be corrected by heel lift alone. This is because the application of a heel lift induces anterior drift of the ileum on that side, which may lead to further complications. Additionally, the lift alters the shape of the interior of the shoe itself and may

leave little support under the inner arch of the foot. When a greater correction is required, the entire sole of the shoe should be raised.

When the use of the heel lift is to treat spinal curvature in an adult without an actual leg length discrepancy, Reinert suggests limiting the amount of the lift to 7mm in order to avoid further complications.

Sacro Occipital Technique

Marjor Bertrand DeJarnette, D.C., the founder of Sacro Occipital Technique (SOT), talked extensively in his early writing and teaching about the use of heel lifts. In one of his early writings he describes a method of assessing for the need of heel lifts.⁶² He suggests placing the patient in front of a plumb line and assessing the contour of the lumbar musculature. He then suggests adding thin pieces of cardboard under the heel of the patient on the side of the body that is cut by the gravity line, and adding up to one inch of cardboard for the purpose of the test. If the lumbar musculature normalizes and the patient is able to stand without pain or muscle strain, then this is an indicator that a heel lift may be of benefit to this patient, at least for a limited period of time.

Over time, DeJarnette developed a complex system of determining when and how to use heel lifts within the SOT system. In a 1952 publication⁶³ he discusses the actual application of heel lifts by suggesting that lifts should be cut into 1/8, 3/16, and 1/4 inch heights. He states

that if a lift greater than 1/4 is necessary, then the sole of the shoe must be built up 1/8 inch of every 1/4 inch added to the heel.

In the 1980s, DeJarnette seems to change his mind about heel lifts. He finds that the use of pelvic blocking creates the leveling of the pelvis and correction of spinal curvatures that he had previously relied on heel lifts to create.^{64,65} It must be assumed, however, that this was only the case in the event of apparent and minor leg length discrepancies, as pelvic blocking cannot correct for the distortion created by a major leg length imbalance.

Dr. Fred Barge⁶⁶

Much of Barge's work is based upon principles from Logan Basic technique; however, it is greatly expanded upon and incorporates information from Diversified and Gonstead techniques as well. Within his famous textbook on scoliosis, Barge dedicates an entire chapter to the use of heel lifts, creating what is likely the most detailed and complex protocol in the chiropractic sphere.

Barge begins with the idea that inferiorities can cause adaptive change in the spine which are not all correctible by spinal adjustment. When looking at a patient with these adaptive changes, it is important to identify the "dominant inferiority". Barge provides the following list of the major causes of inferiorities:

1. *Anatomical short leg.*
2. *Anomalous sacrum – creating a non level surface, unilateral sacral inferiority.*

3. *Sacral subluxation (dropped sacrum) – a sacrum low on one side in its pelvic relationship. This can be complicated with/or caused by #4.*
4. *Pelvic misalignment – can lower the sacrum on one side. (3 and 4 can be combined).*
5. *Anomalies, wedged vertebra, hemi vertebra, etc.*
6. *Disc block subluxations.*

It is critical, in Barge's technique, to utilize radiography, especially the standing full spine x-ray and sacral base x-ray, to aid in the determination of when and where to prescribe heel lifts. The measurements derived from these images help to determine on which side and how great a lift to utilize, based upon the dominant inferiority. He also suggests that x-rays should be used to monitor the progress once a lift has been prescribed, particularly during periods of rapid spinal growth. Table 2 provides a summary of his protocol for lift placement.

Table 2 – Fred Barge Protocol for Lift Placement

Dominant Inferiority	Bilateral Weight Scales	Use of lift	Comments
Sacrum low on left	Weight to left	Left	None to minimal adaptation to inferiority – correct inferiority
Sacrum low on left	Weight even or to the right	Left	Progression of above - Spinal balance achieved through creation of wedging of lower lumbar vertebrae – correct inferiority to eliminate need for wedging
Sacrum low on left	Weight to right	Left	Progression of above - Spine over balanced – be careful there is not a disc block* (most commonly at L4 – see below)
L4 low on right	Weight to right	Left or right	Disc block between L4 and L5 – early with no thoracic curve yet – reduce block via adjusting and then use left lift – if adjusting will not hold, use small right lift temporarily to support adjustment
L4 low on right	Weight even	Left or right	Progression of above - Right rotatory lumbar scoliosis now present with formation of left

			thoracic curve – if L4 disc block adjustment holds use left lift to correct entire problem – if it will not hold use right lift
L4 low on right	Weight to right	Left or right	L4 disc block left uncorrected leading to a 'pull up'** disc block between L5 and sacrum – if L4 adjustment holds use left lift – if it will not hold use right lift temporarily – if problem is too chronic to be corrected then use right lift
L4 low on right	Weight to right	Right or none	Acute disc block causes spine to tip to the right – if corrected by adjustment no lift necessary – if present for over a month use right lift to assist correction – will lead to scoliotic change if left uncorrected
L4 low on right	Weight to right	Right	Progression of above - Rotatory scoliotic change bringing spine back toward midline – right lift will assist adjusting to correct – if too chronic the lift may be permanent
L4 low on right	Weight to left	Right	Progression of above – overcorrection – right lift used with careful monitoring and vigorous adjusting – gradually increase lift to avoid overbalancing
L4 low on right	Weight even	Right	Progression of above - Balanced scoliosis – spine creates additional curve back toward midline – less monitoring necessary - use lift to stabilize correction of L4 subluxation – if correction of scoliosis does not occur lift may be permanent
Sacrum low on right	Weight even or more toward left	Right	Early attempt of spine to achieve balance by tilting toward the left or even crossing midline – if adjusting cannot correct low sacrum then right lift can help stabilize pelvic adjustments
Sacrum low on right	Weight even	Right	Progression of above into more pronounced rotatory scoliosis – if adjusting cannot correct low sacrum then use lift – very successful in youth
Sacrum low on right	Weight even	Right	Further progression into advanced state of scoliosis – correct low sacrum using adjusting – if adjusting not sufficient slowly build up lift to avoid overbalancing spine – in pre-puberty curves must be reduced as they will increase during growth spurt
L5 low on right	Weight even or to right	Right or left	Initiated by unilateral sacral inferiority on left – open wedge between L5 and sacrum on left – nuclear shift disc block at L5 – usually associated with tortipelvis – disc block became chronic leading to scoliotic adaptation – use right lift initially and adjust L5 – if corrected

			remove right lift – re-x-ray sacral base to determine if left lift is necessary to stop recurrence
L2 low on right	Weight even or to right	Right	Base of spine is level – L2 disc block – usually traumatically induced – may be corrected with adjustment only – right lift will assist correction if chronic
?	Weight even or to left	None	Thoracic scoliosis with T11 disc block – idiopathic – scoliosis may be caused by T11 disc block – T11 disc block may be caused by ‘pull up’ from scoliosis – medical consult suggested
Sacrum low on right	Weight even	Right	Typical right rotatory lumbar scoliosis due to low right sacrum – disc block formed at L2 due to transition of lumbar curve into a thoracic curve – a right lift with adjusting in youth may prevent progression – may use lift in adult if adjustments insufficient
L4 low on left	Weight to left	Left	L4 disc block causing scoliosis – spine trying to balance via thoracic and cervical scoliotic curves – left lift with adjusting may correct entire scoliosis in which case remove lift – if complete correction not achieved lift is permanent
L4 low on left	Weight even	Left	Same as above but spine in balance – in youth use lift and adjusting to stabilize spine and limit progression during growth spurts – lift with adjusting may reduce some curves in early adult life

** Disc block refers to inferiorities that initiate a scoliotic bend or lateral tilt. Correction of the block should reduce the tilt. Disc blocks are not found within a scoliotic curve but at the base of the curve with the open wedge on the side of the convexity of the curve above it.⁶⁷*

*** ‘Pull up’ refers to Barge’s “Pull Up Principle” in which a superior vertebral subluxation ‘pulls up’ the vertebra below, creating another disc block. Barge states that when this occurs at the L4 level, pulling up on L5 and creating a disc block between L5 and the sacrum, it can be difficult to determine on x-ray which came first. He believes that when both L4 and L5 show a disc block, it is more often caused by the L4 ‘pulling up’ on the L5 vertebra. He also states that when an open wedge is on the side opposite to a dominant inferiority, it is generally a ‘pull up’ subluxation caused by a scoliosis and compounding the inferiority.*

When it comes to just how much lift to use, Barge generally relies on the Logan Basic principle of the 1:2:4 ratio (see above). He recommends a conservative approach wherein the lift is gradually raised to the desired height. In addition, he believes that x-rays should be used following placement of the lift to determine if the lift affected the spine appropriately, and used

to monitor the progression of the treatment. In some cases a greater lift is necessary than was originally determined, while in others the smaller lift will cause the correction before the entire height has even been reached.⁶⁸

Heel Lift Manufacturers

The majority of the following information was gathered from the websites of two leading heel lift manufacturers, Clearly Adjustable and G.W. Heel Lift, Inc. on 3/23/2009 As a result, this content is subject to change without notice.

Heel lift manufacturer Clearly Adjustable provides suggestions for the treatment of leg length discrepancy, Achilles tendon injuries and stroke rehabilitation. For the treatment of leg length discrepancy the company suggests that the lift will be needed permanently on the side of short leg, and that comfort should be a primary consideration. No more than ½-inch should be used, as any more than that will cause the heel to be lifted out of the back of the shoe, affecting stability. If more than ½-inch is needed, it should be added as a full-foot lift and can be added to either the inside or outside of the shoe. They suggest that, for chronic leg length differences, the appropriate height of the lift should be determined via experimentation, by starting at ½ of the measurement of leg length difference and slowly introducing 2-3 mm per week to allow the body to adapt. For leg length differences of recent origin, such as due to trauma or surgery, the full height of the difference should be utilized to avoid creating any adaptive changes. All shoes worn by the patient should contain the same lift, even in flip flops and slippers.⁶⁹

Many of the same rules apply when utilizing heel lifts for Achilles tendon therapy. The only differences include using the lifts in both shoes equally to maintain balance and avoid creating other problems. They suggest that the use of firm lifts are critical, as soft materials can cause vertical motion in the heel of the shoe, causing rubbing on the tendon which could lead to additional inflammation and worsening of the condition. When healing of the tendon has occurred, the height should be gradually reduced over several weeks to slowly re-stretch the tendon.⁷⁰

Again, similar rules apply when using heel lifts for prosthetic or rehabilitation. Lifts may be used to adjust shoe fit by adding 1-4 mm to tighten the heel pocket fit and shift the foot slightly forward in the shoe. When used with a prosthesis, the lift may be used in either shoe to fine-tune height adjustments or to improve swing-through with the prosthesis. Using a firm, adjustable lift will allow for the best control as well as for minor differences between shoes. Additionally, an adjustable lift is the best option when being used for rehabilitation, as the height can be changed over time as recovery progresses.⁷¹

G.W. Heel Lift, Inc. also provides information on the application of heel lifts for correction of leg length insufficiency. The first step is to perform a screening measure to determine if the leg length difference is due to an anatomic short leg or a functional short leg. To accomplish this, the doctor places his or her hands on the top of the iliac crests and notes if the crests become level when the patient rolls out onto the lateral aspect of both feet. If leveling occurs, then the leg length difference is functional and an orthotic may be a better option. If the crests remain unlevel, then an anatomic short leg is present.

The next step G.W. Heel Lift, Inc. suggests is to take AP Lumbar and Lateral Lumbar x-rays along with a tilt up view of the sacral base. These images should then be analyzed to determine the best placement of a lift to create balance and remove stresses from the L4/L5 and L5/S1 motor units. This should be accomplished by determining the dominant inferiority and deciding if a lift is appropriate to treat this inferiority. When applying the lift, it should be increased by 2 mm every 2 weeks until optimum stabilization has occurred and remain in place for as long as that stabilization is needed. After 4-6 weeks, x-rays should be re-taken to evaluate the progress of the therapy. If greater than 12 mm of lift is needed, the sole and heel of the shoe should be built up, with half of the amount of the heel lift required put into the sole of the shoe.⁷²

Dr. Arthur Gross, founder of G.W. Heel Lift, Inc. provides more detail on the placement of the heel lift with the following rules:

1. *If leg deficiency is less than L5 deficiency, address the leg deficiency.*
2. *If leg deficiency is greater than L5 deficiency, address the L5 deficiency.*
3. *If leg deficiency is zero and there is an L5 deficiency, address the L5 deficiency.*
4. *If L5 deficiency is opposite leg deficiency, address the L5 deficiency.*⁷³

Dr. Gross goes on to suggest that the following conditions do not respond well to heel lifts:

1. *Disc wedging of L5 - When dominant inferiority is due to disc wedging of the L5/S1 disc space with a level sacral base, then a heel lift will not be effective.*
2. *Disc wedging of L3-L4 and higher – When the dominant inferiority is L3 or higher the heel lift will not be effective.*

3. *Idiopathic scoliosis – Usually in idiopathic scoliosis the spine begins its curve at L3 or above. Heel lift procedures will not affect the unleveling at those or higher levels if they are not the dominant inferiorities.*⁷⁴

Finally, Dr. Gross provides some additional tips on the use of heel lifts. He suggests that between the ages of 12-40, 100% relief can be obtained with a 100% lift correction; between the ages of 40-60, 100% relief can be obtained with 50-75% lift correction; and between the ages of 60-80, relief can be obtained with 25-50% lift correction. If pain or discomfort occurs, it will generally be within the first 7-10 days of use. When this happens, reduce the lift by half and wait 2 weeks before raising slowly.⁷⁵

Conclusion

Heel lifts, when properly utilized, can have a significant impact on the quality of life of many patients. Strong evidence exists supporting the use of heel lifts to treat a variety of conditions, particularly low back pain and scoliosis when caused by a leg length deficiency. However, more research is necessary to provide evidence-based support for the theories upon which the various treatment protocols are based. Currently, there is no consensus as to the proper application of heel lifts, and clinicians must choose the one most appropriate for their patient's condition or the one that integrates most effectively with the rest of the patient's treatment plan. The biomechanics of the human body are complex, and patient lifestyles vary widely, thus the impact of lift therapy cannot always be pre-determined. Careful monitoring must be performed to ensure that the lift is having the appropriate therapeutic effect. In some cases, heel lifts can be used to correct a problem, while in others they can support therapies such as manual adjusting. In yet other cases, they are a permanent therapy to compensate for an otherwise untreatable anomaly. Regardless of the cause, when properly utilized, heel lifts can be a powerful adjunct to current therapies and a worthwhile tool about which clinicians should become educated.

Appendix

Table A-1. Comparison of Various Lifts

Heel lift	Wedge shaped shoe insert (tapered posterior to anterior) that is used to elevate one foot in order to accommodate for a symptomatic anatomic leg length inequality or to treat a variety of other conditions such as low back pain or scoliosis. Heel lifts are made of a firm, non-compressible material that allows for exact and constant addition of height to one leg.
Ischial lift	A pad placed under the ischial tuberosity while sitting, which allows for the addition of height to a deficient side in order to level the pelvis.
Heel pad	Shoe insert used primarily for shock absorption.
Logan Wedge	A heel lift that is tapered in the medial/lateral direction in order to compensate for excessive pronation or supination of the foot.
Orthotic	An orthopedic device which is placed in the shoe, and used to correct for anatomic or functional abnormalities of the foot.

Table A-2. Treatment of Leg Length Inequality: Common Distortions and Related Shoe Lift Applications^α

Lateral Distortion Type	Ipsilateral Application	Contralateral Application
Lumbar scoliosis (convexity)	Heel lift	Sole lift/heel drop
Sacral anteroinferiority	Heel lift	Sole lift/heel drop
Sacral posterosuperiority	Sole lift/heel drop	Heel lift
Iliac anterosuperiority	Sole lift/heel drop	Heel lift
Iliac posteroinferiority	Heel lift	Sole lift/heel drop
Unilateral pelvic anteriority	Sole lift/heel drop	Heel lift
Unilateral pelvic posteriority	Heel lift	Sole lift/heel drop
Unilateral low femur head	Plantar lift	
Unilateral short ischium	Ischial lift	
Anteroposterior Distortion Type	Application	
Sprung back (lumbar)	Bilateral heel lifts	
Kissing spines (lumbar)	Bilateral sole lifts/heel drops	
Lumbar hyperlordosis	Bilateral sole lifts or heel drops	
Lumbar flattening	Bilateral heel lifts	
Fixed pelvic anterior tilt	Bilateral sole lifts or heel drops	
Fixed pelvic posterior tilt	Bilateral heel lifts	

^αAdapted by Leach⁷⁶ with permission from Panzer⁷⁷ et al.

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