

# Manual Osteopathic Management of Leg Length Discrepancies

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# Abstract

The leg length discrepancy (LLD) is a biomechanical impediment which is a potential factor in affecting the musculoskeletal disorders in the rest of the life, such as scoliosis, osteoarthritis and muscle tightness or even tenderness in lumbar and pelvis area. The population who obtained leg length discrepancy has symptoms in gait, running, standing posture. In general, a swaying posture when they remove their body from place to place. How doctors or people working in clinic verify or diagnosis the leg length discrepancy? In what means the professionals used to measure the leg length discrepancy? In what age group people will likely to develop leg length discrepancy? How is the etiology of a leg length discrepancy? What possible treatments are used to scope with leg length discrepancy? Besides surgical and orthotics treatments, what manual osteopathic management play a role in this specific disorder? An overview of the mentioned will be discussed in these papers.

# Introduction of Leg Length Discrepancy

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Inequality in leg length is usually associated with compensatory gait which looks swaying abnormally while removing the body. And due to those abnormalities in posture of moving and standing, the pressure of body weight compresses to joints induce degenerative disc and easily gets osteoarthritis in the lower extremities. Patients with leg length discrepancy are commonly having femur or shin bone torsion and deformity, scoliosis can be finally established due to pressure of body weight. Not only lower extremity bone will be potentially damaged but also the soft tissue in the pelvis and lumber area will be contracted tightly and created disorders or tenderness.

In the clinic or hospital, to identify leg length discrepancy, there is a lot of measure to be used, manually by tape measure and by image scanning. Some of them are considered having deviation and some of them are considered to be more reliable and more accuracy. Since technology in scanning image is improving, the means of scanning can be varied nowadays.

The leg length discrepancy also has various causes and symptoms, thus the etiologies are difference. Some of them are considered as true leg length discrepancy and some are considered as functional.

Treatments are normally classified into two different category, prescribed orthotic is used for those patients who has a relatively small in deviation of leg length. And surgery is the final choice to scope with big variation of leg length. When there is a diagnosis of leg length discrepancy, depending on the age, doctors consider how to manage with the patient, usually surgery will be considered for the mature patient, not for patient especially for those who has a continue growth.

In the United States of America, a record sourced from the military recruitment centre showing that a limb length inequality may commonly be a mild variation between two sides of the body. This is not an unusual case in the population worldwide. The figures showing that every 600 military recruits there were around 32 percent out of the total had a 1/5 inch to 3/5 inch in deviation of the leg length. This is a normal variation in population around the world. Merely the greater differences may be necessary to go for treatment since significant difference can be affecting to the outer appearance, well-being and quality of life.

## **What are the causes of a leg length discrepancy?**

There are a lot of reasons behind the development of the disorder of leg length discrepancy, as the scientists are having continue investigation and research on it, we will have more information soon. Some information is known and we can discuss here.

-An injury damaged to bone structure, like fracture of bone, also affecting to the bone cells (epiphysiodesis) which responsible for the growth of the bone, while the corresponding side of leg bone growth normally. Not only fracture of bone will affect bone growing shorter but in some cases, fracture of bone can be affecting the bone growth more faster than normal situation, and causes a bone growth more longer than it should be.

-Infection to bone, due to inflammation to the ends of the long bone in young age before bone maturity, this is a situation of dysplasia, such as juvenile arthritis, neurofibromatosis, multiple hereditary exostoses. For example, osteomyelitis can injure the region of a bone named bone plate where growth in length of long bone.

-Other causes including inflammation of arthritis and neurologic conditions are also affecting to the growth of long bones, like some children they are born with bowed tibia or bone tumors.

-Some of the cases are idiopathic, especially for cases involving under development of the inner or outer side of the leg, or partial growth of one side of the extremity. These conditions are usually acquired at birth, and leg length inequality is not obviously noticeable. Normally when a child grows, the variation of leg length becomes bigger and is being noticed.

-Hemihypertrophy or hemiatrophy are also typical of limb length discrepancy conditions but relatively rare in case. In these cases, the extremities on one side of the body are either longer or shorter than corresponding side of the body. These conditions are also idiopathic.

-Developmental dislocation of hip is a functional leg length discrepancy which is the acetabulum of the femur head subluxation. Hip joint is a ball and socket joint, when the femur head is unstable to sit on the cup (the socket), the pelvis will be hang lower than the other side, it creates the appearance and symptoms of leg length discrepancy.

-A pronated foot is recognized by a flattened longitudinal arch which also referred to a functional leg length inequality. This is happened when the subtalar joint pronates, because of the talus rotating medially.

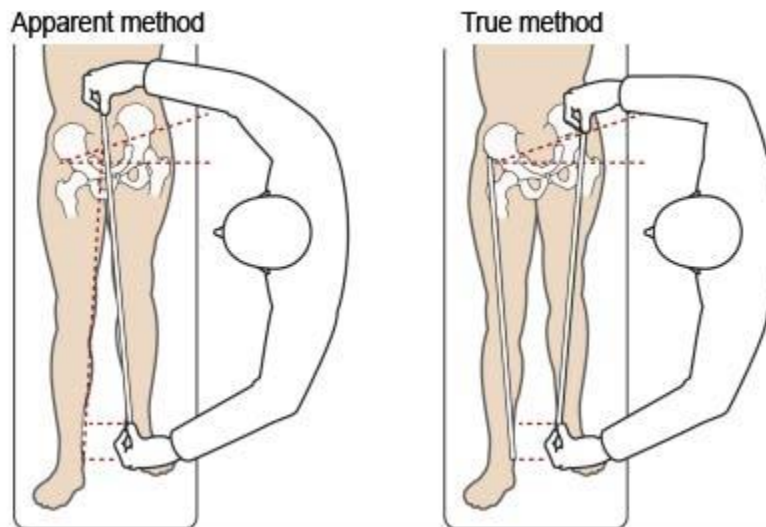
This situation induces the entire lower limb (short leg side) rotates internally. And results in an ipsilateral iliopsoas muscle stretching, then subsequently increased in sacral base angle. The majority of the leg length discrepancy patient experienced pain on the

contralateral side (the long leg side), in the buttock, sacroiliac joint, ipsilateral psoas contraction, gluteal and piriformis tenderness. The symptoms of leg length discrepancy may be varied, such as functional scoliosis, knee, hip and ankle problems.

## Measures for diagnosis of leg length discrepancy

### Tap measure

In some clinics, doctors manually using a tape to measure the leg length discrepancy. There are two different types of measure. When a doctor utilizes a tape measuring from the anterior superior iliac spine to medial malleolus of the ankle, it is named direct measure. And when a doctor uses a tap measure from the umbilicus to the medial malleolus of the ankle, it is named apparent measure. However, the differences in girth of the two legs and difficulty in verifying bony prominences location as well as angular inaccuracy can induce to errors using this clinical measuring tool. Under some circumstances, the appendicular skeleton can be shortened due to contracture of soft tissues surrounding the pelvis and knee areas. In such a case, the measuring method can be inaccurate to acquire the true leg length figures.



### Standing on blocks

There is one more measuring method is to level the pelvis height by placing block of unknown height under the foot of the patient. This is referred “indirect” clinical method. However, this method has its merit in helping patient who has a functional leg length discrepancy and it is a good aid in determination of the height required for the orthotics. In conclusion, this is a measure which is more reliable and accurate than using a tape.

## Imaging methods

### Plain radiography

There are three techniques which being considered as distinct for accessing leg length discrepancy using standard radiography include orthoroentgenogram, scanogram and teleoroentgenogram. These three radiographic methods are being investigated and concluded it is reliable and accuracy techniques.

### Orthoroentgenogram

This technique was introduced initially by Green in 1946. The radiographic technique was developed to minimize the measuring deviation of human errors. The technical requirements were to make three exposures centered over the hip, knee and ankle.

### Scanogram

A technique which was described by Merrill in 1942, but the name of scanogram is no longer used. The patient is instructed to lay supine on the table of the machine, three separate radiographic exposures were made, the images were focused on the center of pelvis joint, knee and ankle. These images were made from anterior to posterior.

### Teleoroentgenogram

This technology is to make an anterior to posterior image of the lower extremity, however, it consists of a single radiographic exposure for both side of lower limb. The x-ray beam centered at the knee from a distance about 6 feet to the patient while the patient is standing with patella pointing to the machine.

### Computed radiography

This is a relatively advance tool in the measurement of leg length discrepancy which is becoming more and more popular. The valid distance in obtaining an image is 6 feet and it should be positioned longer in distance for taller patient. Usually three images individually 35 X 43 centimeter exposures are to be obtained and stored into storage cassette. Afterward the three images will be programmed digitally so that the operator can enhance the images by using the computer to adjust the parameters, this feature is very useful to compare with the other image that patient who requires repeated radiographic examination.

### Microdose digital radiography

This is also a computer aided radiography image which reduces the harmful exposure of radiation compare to traditional radiographic technology by using a vertical gantry, the patient standing in front of the x-ray assembly and remains stationary during the 20-second scanning process. Then a full length anterior to posterior image is obtained .

## Ultrasound

The merit of using ultrasound in leg length discrepancy is radiation free. In this technique, the ultrasound transducer is used to identify the bony landmarks at the hip, knee and ankle joints. This technique is more reliable than the manual tape measure or standing on blocks but it is less reliable than the standing radiography.

## CT Scanogram

Ct scanning is a digital technique which has the advantages of displaying the entire lengths of the femurs and tibias while minimizing the measurement error.

## MRI Scan

The merit of MRI scanogram is not exposing patients to ionizing radiation, the measurements obtained using this technique are slightly less than those obtained with a radiographic scanogram or a CT scanogram. MRI has becoming popular in evaluating the bony abnormalities, the images were obtained using a T1 weighted spin echo sequence and the best coronal images were selected for standardized assessment of femoral length using the classic bony landmarks of the femoral head and medial femoral condyle.

## Treatments

In the normal situation, leg length discrepancy can usually be noticed and identified when patient is young and before bone maturity. Bone structure is still under developing, in this case, patient is normally advised to have some orthotics to assist retifying the moving activities in daily life, and avoiding surgical considerations.

In fact, surgical treatments are not the first consideration, it depends on the severity of the leg length discrepancy, for doctors to recommend surgical treatment. The surgical treatments are divided into two groups, lengthening and shortening, it is depending on which procedure is benefited to the patient in helping them to get satisfactory and resume to normal daily activities.

### Surgical treatments

**Shortening Process** - This technique is used to shorten the long leg and allow the short leg to catch up the long leg after further growing. It is recommended for using on children. In the cases that leg length discrepancy is expected within two to six centimeters at maturity. Also it has an advantage for less in complication and more safety than lengthening procedures.

**Epiphysiodesis** - This process is aimed to slow down the rate of growth of long leg, allowing the short leg to grow to catch up the long leg and expected to narrow the deviation of both legs. The disadvantage of this technique is for the long leg the operation is irreversible.

Epiphyseal Staping - This technique is operated to slow down the growth rate of bone temporary, until the equalization has been achieved, the staples inserted on each side of growth plate will be removed.

Bone Resection - This operation is targeted to cut one section of bone out, the height is equal to discrepancy. The patient who accepts this operation is expected that the bone is mature and no more growing in future.

Lengthening Process - The requirements of this technique is aimed for leg discrepancy of more than 4 centimeters, provided that patient is mature in bone structure and growing is ceased. The technical problem is huge compared with shortening operation since more complications may be occurred unexpectedly. The merit of this operation is to get the desirable height for the short leg.

### Non-surgical treatments

Orthotics - This is a heel lift technique which can be used to treat discrepancy from two to six centimeters.

Prosthetics - This devise is used to assist child who has an amputation or patients with large discrepancy who would not be benefited from lengthening and shortening processes

## **Osteopathic managements**

As leg length discrepancies is a disorder of musculoskeletal problems which affecting the muscles of low back & lower extremities. In this case, patient obtains short leg syndrome, and osteopathic manipulation technique is being considered as a very effective technique in alleviating patient's musculoskeletal problems.

### A. Piriformis Syndrome

This syndrome is considered a neuromuscular problem. Since the tightness of piriformis, the sciatic nerve is being compress and creates pain. If situation becomes chronic, compensatory changes resulting in pain, paresthesia, somatic weakness and somatic dysfunction. Osteopathic manipulation techniques are counterstrain, myofascial release, muscle energy technique.

### B. Contracture of Quadratus Lumborum

As the iliac crest of leg length asymmetry is one side anterior superior while contralateral side is posterior inferior, the pelvis is slant, torque and unbalance. In this case, the quadratus lumborum is one side stretched and one side contracted.

In osteopathic manipulation, the muscle stretching technique for quaratus lumborum is helpful to release the contracture soft tissue. Other techniques like counterstrain, muscle energy technique are effective for treatments.



### C. Contracture or overstretching of Gluteus Maximus, Medius, Minimus

As postural imbalance in removing their body while daily activities, patients with LLD have to use the gluteal abductors to keep balance, this compensatory movement may become a chronic disorder for soft tissue. In osteopathic manipulations, the stretching of the gluteal abductors as well as counterstrain techniques are an effective way to release the contracture of muscles. Besides, there is also a potential disorder for gluteal abductors is trochanteric bursitis at the insertion of muscles. In this case, except osteopathic treatments, therapeutic exercises are also a very good management to educate patient for keeping muscles health.

### D. Sacroiliac Joint Dysfunction

Sacroiliac joint is a shock absorber facility in our skeletal structure while we are moving our bodies. The LLD is even compressing and rubbing in the joint more than normal balanced pelvis. In this case, the degenerative of joint disc or osteoarthritis is speeded up compare to normal population. In osteopathic manipulation techniques, the managements are included Muscle energy technique, such as combined reciprocal inhibition and muscle contracture mobilize articulation and post isometric relaxation techniques.

### E. Scoliosis

Scoliosis is a compensatory spine changed of leg length asymmetry due to chronic compress of upper body weight imbalance. To keep the balance of body for standing & moving, muscles along the spine are being contracted and stretched more severely than the normal population. There are lots of osteopathic manipulation techniques to be used to keep spine health, such as muscle energy technique of post isometric relaxation technique & high velocity low amplitude HVLA technique on lumbar region.

### F. Hip & knee Joint Osteoarthritis

As the imbalance of daily activities of leg length asymmetry, the hip & knee joints are being rubbing more heavier than normal population. Osteoarthritis is more likely happened to related patients. In osteopathic manipulations technique, soft tissue technique and joint mobilization are worthy recommended to handle the above symptoms.

### G. Low Back Pain

One of the reason behind the low back pain is the sacroiliac joint dysfunction. Since the slant of pelvis, the body weight compressed severely on the sacroiliac joint and in case situation becomes chronic, the buttock, groin area as well as low back is painful. The situation is quite similar to radiculopathy. Sometimes, the tightness of the quadratus lumborum can also be a cause of low back pain. In osteopathic manipulations technique, besides soft tissue technique, the stretching of quadratus lumborum, counterstrain technique for QL muscle, mobilization technique using for sacroiliac joint are useful.

### H. Tensor Fasciae Latae Contracture TFL

AS most of the LLD patients obtain asymmetry of pelvis, during daily activities, the pelvis is medial rotated, abducted and flexed. Thus, the TFL muscle is potentially overloaded. In the osteopathic manipulations technique, muscle energy technique, counterstrain technique as well as stretching of pelvis technique are effective.

## **Discussion**

Short leg discrepancy has quite a long history in existence, as some of the cases caused by accident injury, and some of them are caused by diseases, some of them are idiopathic which scientists are still making their effort to dig out more knowledge in the related areas. However, the LLD patient obtains lots of dysfunctions in musculoskeletal problems. The skeletal regions related to the disorder may be found at lumbar spine, ilium, hip joint, greater trochanter and knee or even ankle and plantar. The muscles involved in these areas are a lot! In osteopathic managements, the manual practitioner can use a lot of basic techniques to handle with these dysfunctions. The above mentioned examples are a small portion among LLD patients. In fact, there are also disorders in the ankle or even plantar area, such as plantar pronation syndrome. To cope with musculoskeletal problems, osteopathic manipulation techniques would be an ideal modality to alleviate syndrome of Leg length discrepancy.

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