Ontario

Limping and Back Pain

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Orthopaedics

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This medical discussion paper will be useful to those seeking general information about the medical issue involved. It is intended to provide a broad and general overview of a medical topic that is frequently considered in Tribunal appeals.

Each medical discussion paper is written by a recognized expert in the field, who has been recommended by the Tribunal's medical counsellors. Each author is asked to present a balanced view of the current medical knowledge on the topic. Discussion papers are not peer reviewed. They are written to be understood by lay individuals.

Discussion papers do not necessarily represent the views of the Tribunal. A vice-chair or panel may consider and rely on the medical information provided in the discussion paper, but the Tribunal is not bound by an opinion expressed in a discussion paper in any particular case. Every Tribunal decision must be based on the facts of the particular appeal. Tribunal adjudicators recognize that It is always open to the parties to an appeal to rely on or to distinguish a medical discussion paper, and to challenge it with alternative evidence: see *Kamara v. Ontario (Workplace Safety and Insurance Appeals Tribunal)* [2009] O.J. No. 2080 (Ont Div Court).

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LIMPING AND BACK PAIN

Introduction

The Tribunal may be asked to consider appeals related to leg and knee conditions caused or aggravated by previous compensable back injuries that have progressed to the development of degenerative lumbar disc disease and mechanical low back pain. It is often claimed, for example, that a compensable back condition with acute sciatica has resulted in limping, which in turn has caused a tear of a knee meniscus. The opposite claim is also made, that a pre-existing congenital or degenerative back disorder is aggravated by limping, secondary to a compensable knee injury such as a meniscal tear or post-traumatic chondromalacia of the patella. On occasion, it is claimed that a meniscal tear of one knee and a lumbar disc problem was caused by limping as a result of a compensable opposite knee condition such as a tear of one of its menisci. Plantar fascitis has also been claimed as causing aggravation of a pre-existing back, hip or knee condition secondary to limping, precipitated by foot pain.

There is very little information in the medical literature about limping. Most clinicians have a limited understanding of the impact of limping on the musculo-skeletal system and in general, believe that limping causes the patient to put extra weight on the opposite normal leg, causing it and the limping individual's spine to transmit increased loads while walking. To understand the problem, some knowledge of limping as well as the pathophysiology of back pain is required.

Pathophysiology of Back Pain

Back pain is common, its causes are generally related to congenital or acquired conditions. Congenital conditions, which may cause back pain, include entities such as spondylolysis (a bony defect in the posterior portion of the lumbar vertebra), which in turn may cause spondylolisthesis (a shift of one vertebra relative to the other due to resultant instability at that particular level), spina bifida and transitional (abnormally shaped) vertebrae at the lumbo-sacral junction. Acquired causes of back pain are most commonly degenerative related to the normal aging process or to injury of the spine involving either soft tissue elements, i.e. abdominal and lumbar musculature, spinal ligaments and discs or injuries to bone such as vertebral fractures. Although rarely work related, other causes of back pain include infection, malignancy - either primary or metastatic, and vascular problems such as an abdominal aneurysm.

Adjacent spinal vertebrae are coupled anteriorly by a soft tissue disc, posteriorly by facet joints and by interconnecting ligaments (Fig. 1). The central portion of the disc is composed of an incompressible gel, which is contained by a tough, outer fibrous wall connecting the vertebral bodies. Disc herniation occurs when the outer fibrous coating, annulus fibrosis, is breached either from injury or by the normal degenerative wear and tear process that allows the gel-like central material to escape or herniate into the spinal canal, sometimes compressing an adjacent nerve root (Fig. 2). This causes sciatica. Disc herniation is more common in younger individuals because the central disc material, the nucleus pulposus, remains in a semi-fluid gel-like state. With increasing age, the annulus fibrosis and the nucleus pulposus lose some of their elasticity and shrinkage of the disc occurs. This is seen on plain X-rays of the back as a decrease in the height of the vertical vertebral disc space. Progressive narrowing of the intervertebral disc space with increasing age causes degenerative change in the posterior facet joints and causes osteophytes or bone spurs to develop along the bony margins of the adjacent vertebral bodies. With further narrowing of the disc space, joint motion is reduced between the vertebral segments and the joint between the vertebrae becomes stiff.

Diagnosis

Although X-rays show evidence of spinal arthritis, e.g. disc space narrowing and vertebral spurring, there is usually little correlation between plain X-rays of the lumbo-sacral spine and specific symptoms. A CT scan will often show a disc herniation causing sciatica but because there is no clear differentiation between disc and neural tissue, a CT scan with contrast (dye injection) may be required to clearly show the outline of the dural sac containing the spinal cord and exiting nerve roots. An MRI is a non-invasive procedure. There is no radiation involved. Better than a CT scan, it usually provides good visualization of neural tissues. Clinical correlation, i.e. history and physical findings with radiological assessment is always required to establish an accurate diagnosis of the possible causes of back and lower extremity pain, as abnormalities are commonly seen in CT or MRI images in people with absolutely no symptoms.

Spine Mechanics

It is often claimed that degenerative disc disease of the lumbo-sacral spine is either caused by an injury to the back or develops as a result of injury to an extremity that in turn results in a limp during walking. Standing in an erect position or level walking is unlikely to create abnormal stress levels in the coupled vertebral segments. Under these conditions, the spinal segments are primarily subjected to axial compression loading, generally of low to moderate magnitude because the centre of gravity of the body is aligned directly over the vertical axis of the spinal column. Minimal force in the anteriorly located abdominal or posterior erector spinal muscles is required to balance the spinal column. Any condition, however, that results in a major displacement of the centre of gravity of the body's mass away from the vertical axis of the spine, e.g. forward bending, lifting, or a large, protuberant abdomen, will create increased forces in the erector spinal muscles in order to balance the spine. This, in turn causes increased force transmission across the spine segments. Major side to side (lateral) displacements of the body's centre of gravity can also increase spinal load due to increased force transmission by the paraspinal muscles required to stabilize spinal segments. The question is whether limping can also accelerate the degenerative process of the spine or aggravate a pre-existing spinal condition and thereby affect the magnitude of load transmitted by the spinal segments (force.)

Types of Limp

The reader is referred to the discussion paper "Symptoms in the Opposite or Uninjured Leg" by W. R. Harris and Ian J. Harrington. This outlines the mechanics of normal gait and how it is affected by limping. There are three basic limps; paralytic, antalgic and short leg.

Paralytic

In the paralytic type, one or more leg or hip girdle muscles are weakened by disease, e.g. poliomyelitis, or injury, e.g. to a nerve supplying a muscle. For example, if the muscles that move the leg away from the body (the abductors of the hip) are weak, then when the patient stands on that side his body tends to fall to the opposite side. To prevent this, he has to move his trunk over the weakened hip producing a characteristic lurch called a Trendelenburg lurch or limp. In another example, if the muscles that lift the forefoot off the ground are weak, it causes the forefoot to drop during the swing phase of gait (a drop foot). To prevent stubbing his toes, the patient has to lift his leg higher during its swing phase in order that his foot can clear the ground producing a characteristic gait called "steppage" or "dangle foot." Because more time is required to get the paralyzed leg into position, its swing phase is prolonged. This, in turn, means that the stance phase of the opposite normal leg is prolonged while it waits for the weak leg to "catch up." In addition to these examples, hemiplegia (stroke) and cerebral palsy also cause a limp. The limp associated with amputation fits into the paralytic type. The predominant walking pattern is that of a Trendelenburg lurch over the amputated limb.

Antalgic

The easiest way to picture an antalgic gait is to imagine that a stone is in your shoe or a nail is sticking through its sole. It hurts when you take weight on that foot and you lessen the discomfort by getting off it as quickly as you can. In other words, you shorten the duration of the stance phase on this side. This produces a characteristic gait with uneven strides of different duration. Any condition that causes pain in a limb: bone or soft tissue injury or referred pain such as sciatica, can produce an antalgic gait.

Short Leg

In this limp, there is a dip when the short leg is in stance phase. But how short is short? It is probable that shortening of less than 5 cm. does not cause an appreciable limp. Anything more than that probably does.

In addition to these three basic types, there is another condition that may cause limping and certainly could increase loading of the spine. This is arthrodesis or fusion (deliberate stiffening of a joint to cure infection or pain.) The fusions most commonly seen are of the hip, knee and ankle. As a rule, limping when present is not marked and more apparent to the patient than the observer. But these joints act as shock absorbers for the spine and when they are fused, could increase strain on the spine thus initiating or aggravating degenerative change in it.

The Biomechanical Effect of Limping on the Spine

With limping, there is a shift of the body's centre of gravity towards the affected leg. This results in lateral bending of the trunk towards that side (Fig. 3). Depending on the magnitude of the limp, there will be an exaggerated side to side and vertical displacement of the body's centre of gravity. When weight is transferred to the good leg, the repositioning of the centre of gravity in the mid-line is in part due to the pull of the para-lumbar, spinal and abdominal musculature on the normal side. The increased muscle pull increases the force transmitted across the lumbar discs and facet joints. This produces a seesaw effect where the disc centres become the centres of rotation or fulcrum for the para-lumbar muscle force, balancing body weight. This is a lever system of the first class. The repetitive pull of the trunk musculature in time may result in increased wear and tear to the disc segments since the force transmitted across the discs would be greater for an individual who limps than for someone with a normal gait. This, in turn, might cause or aggravate degenerative change (osteoarthritis) of the disc and facet joints.

Another biomechanical factor, which is operative here, is the compensatory lumbar scoliosis (side to side curvature) that may occur for those patients whose limp is due to significant leg length discrepancy. The lumbar curvature may accelerate the degenerative process.

The above biomechanical actions are occurring in the frontal (i.e. as viewed from the front) plane. However, the same mechanism will occur in the sagittal (i.e. as viewed from the side) plane, particularly for those patients whose limp is due to limb paralysis resulting in compensatory trunk movements in both planes in order to keep the centre of gravity centred over the affected limb. The net result is an increase in the load transmitted by the spine.

It will be seen that as each type of limp causes an unusual shift of the trunk. Over time, this may accelerate normal aging change and thus cause back symptoms. In addition, in patients with pre-existing back discomfort, it could aggravate the symptoms.

Above-the-knee amputees have a Trendelenburg limp where the trunk arches towards the artificial leg, which in turn activates the spinal musculature as described above. As a result, amputees often complain of back discomfort. It is worth noting that both Veterans' Affairs, Canada and the Workplace Safety and Insurance Board recognize this in assessing the amount of pension to be awarded. This does not occur in below-the-knee amputees who retain a normal gait.

Conclusion

Limping can, in some specific instances, cause back pain and aggravate pre-existing back pain.

Evaluating Appeals

In evaluating such appeals, the following should be established:

1. That the limp was documented.
2. The limp was caused by the compensable injury
3. If possible, the type of limp.
4. Did the limp pre-exist the compensable injury? If so, were there associated back symptoms?
5. Was there pre-existing back discomfort? If so, was it aggravated by the work related limping?

Related Issues

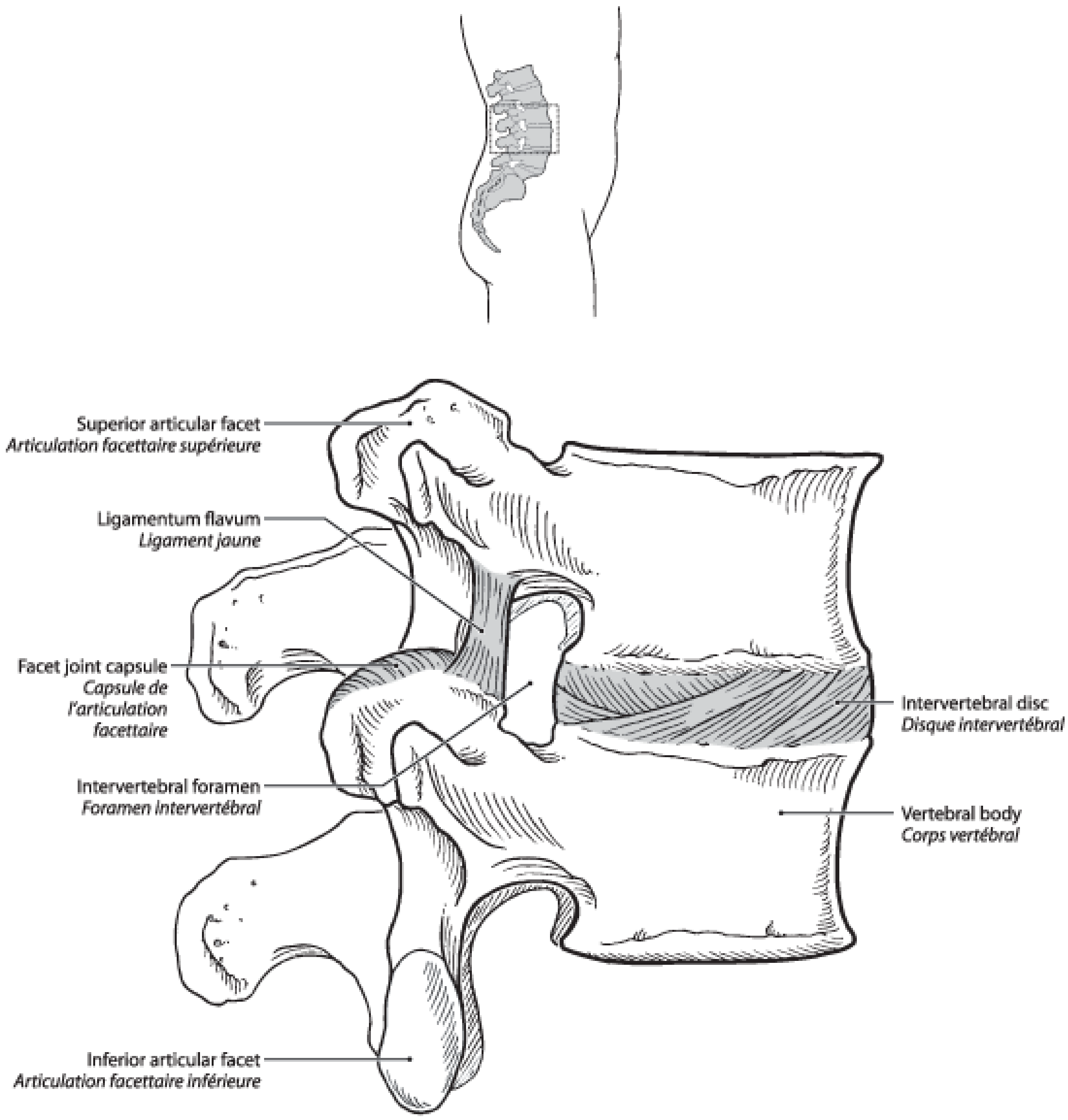
Can a back injury cause knee/leg conditions? It is often claimed that a previous compensable back injury with degenerative disc disease and resulting mechanical low back pain can cause or aggravate osteoarthritis of the knees due to increased knee joint stress precipitated by the back problem. The exact cause of knee osteoarthritis is uncertain but it is known that factors such as excessive body weight, injury or any activity that creates excessive force transmission across the bearing surface of the joint can initiate or aggravate an existing arthritic condition, basically due to the wear and tear phenomena.

Lower extremity joint force tends to increase with walking speed so that force transmission is greater for young, fit individuals than for those who are elderly and disabled with a slow gait. It is commonly believed that injury to one leg can precipitate symptoms in the opposite uninjured limb (see discussion paper "Symptoms in the Opposite or Uninjured leg" by W. R. Harris and I. J. Harrington which outlines the mechanics of normal gait and how it is effected by limping), however, from a biomechanical perspective, there is no clear evidence to suggest that an injury to one leg can cause major problems with the opposite uninjured leg except for certain specific conditions, i.e. a major leg length discrepancy where the injured leg becomes significantly shorter than the normal leg by 5 cm. or more, or when a severe Trendelenburg lurch develops because of injury or paralysis to one lower extremity creating extra stress in the uninjured limb. It follows then that a back problem is unlikely to cause increased force transmission at the knee unless the spinal problem is of such severity that it results in lower extremity muscle paralysis which in turn causes an obvious limp from a severe Trendelenburg lurch; the opposite normal leg would then be subjected to increased load (force transmission). A similar situation would result from an antalgic gait secondary to leg pain due to sciatica. In both instances, however, it would probably be necessary for the limp to be severe and prolonged for it to have any significant impact on the initiation or aggravation of arthritis of the spine.

If the back problem caused a limp that resulted in the individual walking with a significant Trendelenburg lurch, this, in theory, could cause increased stress in the normal leg, i.e. the limb that is not responsible for causing the lurch. It would be necessary, however, for the Trendelenburg gait pattern to have been present for an extended period of time to have any permanent effect on the spine. Also since the activity level of patients with chronic low back conditions resulting in mechanical low back pain is limited, i.e. decreased walking speed, it is unlikely that their lower extremities would be subjected to greater than normal force since the overall magnitude of joint force transmission by the lower extremities is directly related to walking speed.

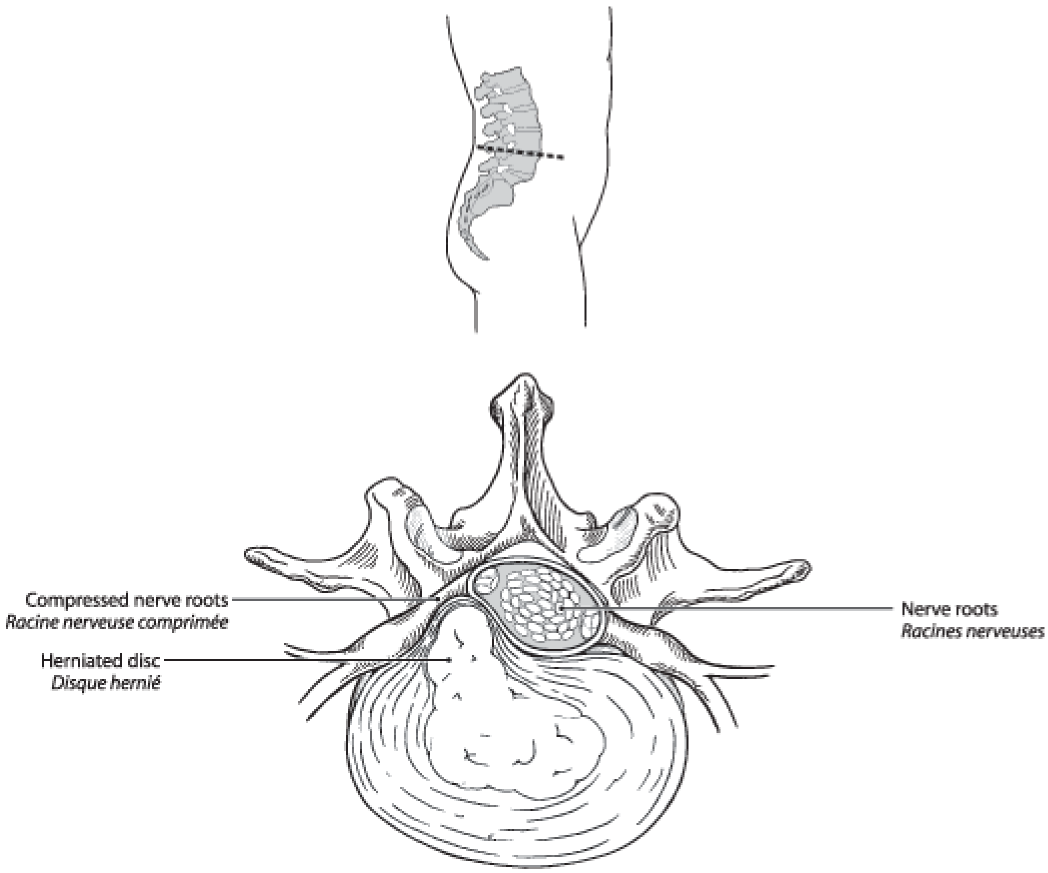
Back problems of lesser magnitude causing mechanical low back pain without a significant alteration in gait pattern, i.e. major limp with Trendelenburg lurch, are unlikely to cause increased force transmission in the weight bearing joints of the lower extremity, e.g. knee. These types of back conditions are not likely to generate the magnitude of force necessary to cause a meniscal tear. Meniscal tears are usually caused by a major combined compression and twisting force (torque), which would not occur from a minor alteration in gait pattern.

Can knee/leg injury cause back problems? It is also unlikely that injuries such as a meniscal tear involving either the medial or lateral meniscus or any condition, e.g. chondromalacia of the patella etc., that caused a mild or moderate degree of limping over a relatively short period of time would have any major detrimental effect on the lumbar spine or opposite lower extremity. Foot and ankle problems causing a temporary limp of low magnitude are also unlikely to create load transmission of any significant magnitude to cause additional stress on the spine or other leg.



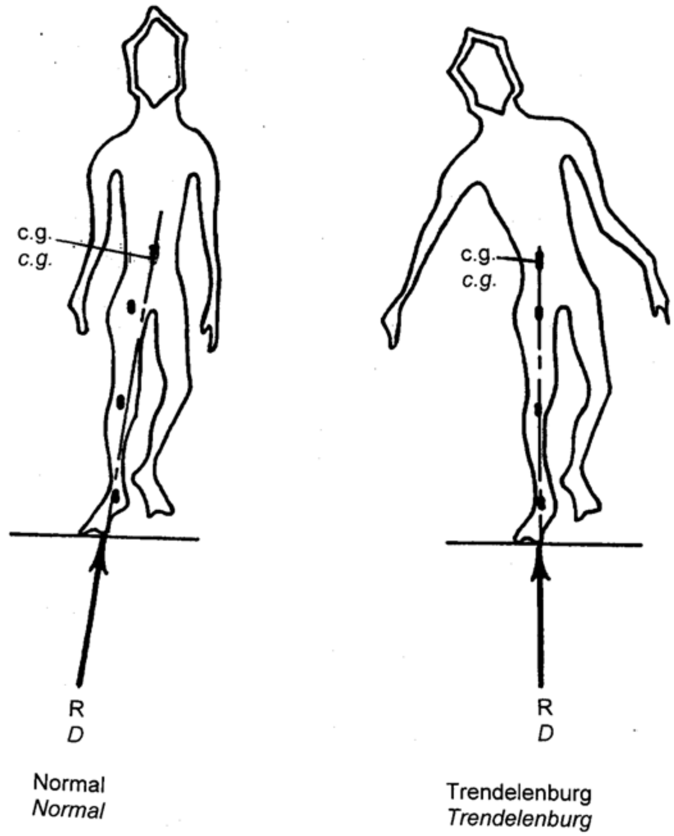
Side view of normal vertebrae showing ligaments and intervertebral disc
Vue latérale d'une vertèbre normale montrant les ligaments et le disque intervertébral

Figure 1



A ruptured (herniated) nucleus pulposus compressing the nerve root, as seen on cross-section.
Coupe transversale montrant un nucleus pulposus hernié comprimant la racine nerveuse.

Figure 2



TRENDELENBURG LURCH DUE TO
LIMPING CENTRE OF GRAVITY SHIFT
Boiterie de Trendelenburg entraînée par un déplacement du centre de gravité

Figure 3

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