A SIGN OF SCIATIC NERVE ROOT PRESSURE

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Although an extruded intervertebral disc has become recognised as the most common cause of sciatica, there are still pitfalls in the diagnosis. The concept that there might be a mechanical cause of sciatica as opposed to the inflammatory theory was first postulated in 1911, when Goldthwait ascribed the onset of paraplegia during manipulation, in a patient with "sacro-iliac subluxation," to a displaced intervertebral disc. Middleton and Teacher (1911) recognised an extrusion of a nucleus pulposus as being the cause of paraplegia at necropsy on a patient who had been merely lifting a heavy steel plate. They tried to reproduce extrusion of the nucleus on cadavers by exerting compression on a flexed spine. But it was not until 1934 that Mixter and Barr put the concept of sciatica on a firm mechanical basis by their demonstration that an extruded intervertebral disc is the common cause.

Anatomical attachments of the lumbar and sacral nerves—O'Connell (1943) has emphasised that compression of the lumbar nerve roots between the protruded disc and the ligamentum flavum is uncommon because the nerve roots act as guy-ropes holding the dura forwards, so that there is a wide space posteriorly in the lumbar vertebral canal. The nerve is tethered proximally through the continuity of the dura mater with the fibrous tissue in the nerve root; by virtue of this attachment the nerve shifts cephalad when the sub-arachnoid space is distended by jugular compression and when the attachment of the dura mater to the foramen magnum is moved during flexion of the neck. Distally, the nerve fibres are attached to muscle and skin. Thus a sciatic nerve root is fixed at each end (Fig. 5), and though it is free to glide between its attachments it has no freedom of movement forwards.

The effect of straight leg raising—When straight leg raising reproduces sciatic pain the sign is regarded as evidence of root pressure produced by a protruded disc. The exact mechanical basis of the test has been the subject of controversy. This problem has been investigated by the author in experiments on a cadaver which are described in a later paragraph.

THE POSTERIOR TIBIAL NERVE SIGN

In 1946, at an operation for suture of a sciatic nerve undertaken by Dr James E. Bateman, it was observed that pressure upon the posterior tibial nerve where it bridged the popliteal space increased the strain on the suture line. It was suggested that this observation might form the basis of a useful clinical test in the investigation of patients with sciatica. The test is performed as follows: straight leg raising (that is, passive flexion of the hip with the knee fully extended) is carried out first on the affected side and then on the sound side (Fig. 1). When the limb has been raised to the point when pain is produced, the knee is flexed about 20 degrees and the limb is then raised further, to a point just short of that which again causes pain (Fig. 2). Firm pressure applied to the middle of the popliteal space, over the posterior tibial nerve, causes sharp pain in the lower lumbar region or in the affected buttock. In the sound limb the test either causes no pain at all or causes pain in the lumbar region or in the opposite buttock. The slight local tenderness of a normal posterior tibial nerve is overshadowed by the gluteal pain when the sign is positive.

AN EXPERIMENTAL STUDY

To demonstrate the mechanical basis of the straight leg raising test and the posterior tibial nerve test experiments were made on a fresh cadaver. The psoas major muscle was
The posterior tibial nerve test. The straight leg is raised to the pain-producing angle (Fig. 1). The knee is then flexed about 20 degrees and digital pressure is applied sharply to middle of the popliteal space where the posterior tibial nerve can frequently be palpated (Fig. 2).

Fig. 3
Apparatus for recording pressure changes in the experiments described in the text.

Fig. 4
Tracing of a smoked-drum record of the posterior tibial nerve sign. A is the increase in tension on straight leg raising. B is the decrease in tension on flexing the knee about 30 degrees. C represents the changes in tension caused by alternately pressing and releasing the posterior tibial nerve in the popliteal space. D is the point at which the knee is extended to usual straight leg raising position.
removed and the fourth and fifth lumbar nerve roots were exposed. The intervertebral foramens were enlarged and the fourth lumbar root was displaced slightly by a rubber bulb inserted anteriorly in the usual position of an extruded disc. The bulb was attached through water-filled tubing with a tambour. Changes of pressure within the bulb were recorded on a smoked drum through a lever activated by the tambour (Fig. 3). Changes in the tension of the roots were noted during straight leg raising and during the posterior tibial nerve test (Fig. 4). Straight leg raising increased the tension (A in tracing), which was immediately lowered by flexing the knee about 20 degrees (B in tracing). Pressure on the posterior tibial nerve increased the tension almost as much as the initial straight leg raising (C in tracing represents repeated application of pressure). The mechanical basis of the tests, as deduced from these experiments, is illustrated in Figures 5 and 6.

![Fig. 5](image)

**Fig. 5**
Mechanical basis of the posterior tibial nerve test. The attachment of the sciatic nerve distally to the skin and muscles and proximally to the dural sheath is indicated. The intervening part is free to slide. Pressure on the nerve in the popliteal space increases the tension on the nerve when the hip is flexed sufficiently to take up the slack.

![Fig. 6](image)

**Fig. 6**
The sciatic nerve has an angular course from the intervertebral disc forwards to the anterior surface of lateral mass of the sacrum and then back to the posterior surface of the acetabulum. This explains why small disc extrusions may produce marked pressure effects.

**DISCUSSION**
Mixter and Barr (1934), Bradford and Spurling (1941), Charnley (1951) and others have emphasised that the straight leg raising test is the most informative clinical sign in the diagnosis of extruded intervertebral discs and in assessing progress after non-operative treatment. The posterior tibial nerve sign has been found to be a useful refinement of the usual test. It has been employed to distinguish between pain referred down the leg from a fibrositic nodule (a rare but definite entity) and true sciatic pain from nerve root pressure. Patterns of referred pain for each sclerotome were observed consistently by Kellgren (1948) when he injected the interspinous spaces with hypertonic saline. These pain patterns of the lower lumbar spaces simulate the patterns of pain from nerve root pressure very closely. Lewis
(1942) believed that referred pain from the deep structures was due to localisation to the skin by the cerebrum of all impulses from the particular nerve fibre. This concept of referred pain suggests how a lesion of the connective tissue, muscle, or even of bone, may produce pain of the same distribution as that from nerve root pressure. The posterior tibial nerve sign helps to eliminate the false positive straight leg raising test that may sometimes be observed in cases of referred pain unassociated with nerve root pressure. Unless the lesion is directly related to the nerve root, the posterior tibial nerve sign is negative. The test may be positive however when there is pressure upon the nerve in the spine or pelvis, whatever the cause of the pressure.

It may be argued that dorsiflexion of the ankle at the limit of straight leg raising will produce the same effect as posterior tibial nerve compression. But a brisk movement of the ankle is usually accompanied by movement of the hip or of the back which can be misleading. The posterior tibial nerve sign offers a convenient method of moving only the sciatic nerve.

**SUMMARY**

Experiments have shown that the tension of the sciatic nerve roots is increased when the posterior tibial nerve is pressed upon in the popliteal space. A refinement of the straight leg raising test, based on this observation, is described.

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**REFERENCES**