

The nerve supply of the lumbar intervertebral disc

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FROM ABSTRACT:

The anatomical studies, basic to our understanding of lumbar spine innervation through the sinu-vertebral nerves, are reviewed.

Research in the 1980s suggested that pain sensation was conducted in part via the sympathetic system. These sensory pathways have now been clarified using sophisticated experimental and histochemical techniques confirming a dual pattern.

One route enters the adjacent dorsal root segmentally, whereas the other supply is non-segmental ascending through the paravertebral sympathetic chain with re-entry through the thoracolumbar white rami communicantes.

Sensory nerve endings in the degenerative lumbar disc penetrate deep into the disrupted nucleus pulposus, insensitive in the normal lumbar spine.

Complex as well as free nerve endings would appear to contribute to pain transmission.

The nature and mechanism of discogenic pain is still speculative but there is growing evidence to support a 'visceral pain' hypothesis, unique in the musculoskeletal system.

This mechanism is open to 'peripheral sensitisation' and possibly 'central sensitisation' as a potential cause of chronic back pain.

THIS AUTHOR ALSO NOTES:

During the last two decades many studies have provided information about the innervation of the normal and degenerative lumbar disc.

The sinuvertebral nerve is "formed by a fine sympathetic branch, usually arising from the grey ramus communicans, and a fine sensory spinal branch from the ventral ramus."

"These conjoined sinuvertebral nerves re-entered the vertebral canal through each intervertebral foramen to lie anterior to the nerve root in association with the segmental vessels."

“The sympathetic fibres were considered as vasomotor efferents and the sensory fibres as proprioceptive and nociceptive.”

Sinuvertebral nerve branches innervate the posterior longitudinal ligament, the outer layers of the annulus fibrosus, and the anterior dura.

“The lumbar sinuvertebral nerves had up to three segmental levels of overlap, which might explain the poor localisation of low back pain.”

The anterior part of the disc annulus is innervated solely from sympathetic nerves. Other parts of the disc are 90% innervated by sympathetic nerves. It is probable that these sympathetic nerves are conveying pain afferent information to the central nervous system, indicating “low back pain is a kind of visceral pain.”

Studies indicate that “afferent nerve fibres from the annulus pass into the sympathetic chain to re-enter the sensory nerve roots at L1 and L2.”

Other studies state “this experiment has confirmed the presence of a clear nociceptive pathway of sympathetic afferent discharge from the dorsal aspect of the lower lumbar intervertebral discs to the dorsal roots of L2,” indicating that “lumbar discogenic pain is indeed a variety of visceral pain.”

Electrical stimulation to the annulus of an upper lumbar disc produces multilevel bilateral motor unit action potentials in the lumbar multifidus musculature. “It is reasonable to propose that the annular stimulus was transmitted via the widespread non-segmental sympathetic afferents.” The pattern of response suggests a spinal reflex to the anterior horn cells.

Electrical stimulus to an adjacent facet joint caused only a localized, unilateral response multifidus contraction. “Distension of the adjacent facet joint with saline depressed the motor unit action potentials.” **[Important for chiropractors]**

“Normal nucleus pulposus and inner annular zones are devoid of nerves.” The three outer lamellae of the disc are innervated with nociceptive afferents.

Nerves can extend to the inner third in 50% of painful degenerative discs. These nerves arise from granulation tissue growing into the degenerative disc, “neoinnervation.”

Disc and/or facet inflammation can sensitize local mechanoreceptors into becoming pain afferents, resulting in chronic discogenic pain. **[Important]**

“The authors of a number of recent papers suggest that the sensory nerve supply of the disc is similar to that of certain enteric structures and represents a form of visceral pain.”

“There is growing evidence that these pain receptors are peripherally sensitised by the activity of sympathetic efferents.”

Disc nociceptive afferents “may initiate a pain impulse in response to ischaemia, pressure changes (mechanoreceptors) or inflammatory irritation.”

[Important for Chiropractors]

Psychological stress can activate the ‘central sensitisation’ of the descending autonomic nerves which may lower the threshold for disc nociception, adding to chronic discogenic pain.

“There is something unique about the nerves related to the spine and the spinal canal which makes the source of pain different from the rest of the musculoskeletal parts of the body. Could the answer be that the disc, unlike other joints, is uniquely provided with a predominantly visceral-type of nerve supply?”

KEY POINTS FROM DAN MURPHY

- 1) Viscera is innervated by sympathetic nerves.
- 2) The intervertebral disc is also innervated primarily (90%) by sympathetic nerves.
- 3) Disc sympathetic nerves are capable of sending nociceptive information to the sympathetic nervous system.
- 4) Disc pain is different than all other musculoskeletal pain because it is a form of “visceral pain.”
- 5) The sympathetic component of disc innervation is found in the sinuvertebral nerve.
- 6) The lumbar sinuvertebral nerves have up to three segmental levels of overlap, “which might explain the poor localisation of low back pain.”
- 7) Degenerated discs are more extensively innervated than normal discs.
- 8) Sensory nerve endings in the degenerative lumbar disc penetrate deep into the disrupted nucleus pulposus, which is insensitive in the normal lumbar spine.
- 9) The sympathetic nerve fibers that innervate the lower lumbar discs enter the central nervous system through the sensory nerve roots at L1 and L2.
[This could be an important target for chiropractic adjustments]
- 10) “Lumbar discogenic pain is indeed a variety of visceral pain.”
- 11) Disc irritation produces bilateral contraction of the lumbar multifidus.

- 12) Facet joint irritation produces unilateral multifidus contraction.
- 13) Distension of the facet joint inhibits the multifidus muscle contraction.
[Important for chiropractors]
- 14) Disc and/or facet inflammation can sensitize local mechanoreceptors into becoming pain afferents, resulting in chronic discogenic pain. **[Important]**
- 15) Pain receptors are sensitized by the activity of sympathetic efferents.
- 16) Disc nociceptive afferents “may initiate a pain impulse in response to ischaemia, pressure changes (mechanoreceptors) or inflammatory irritation.”
[Important for Chiropractors; subluxation can cause pressure changes affecting mechanoreceptors]
- 17) Psychological stress can activate the ‘central sensitization’ of the descending autonomic nerves which may lower the threshold for disc nociception, adding to chronic discogenic pain.
- 18) “There is something unique about the nerves related to the spine and the spinal canal which makes the source of pain different from the rest of the musculoskeletal parts of the body. Could the answer be that the disc, unlike other joints, is uniquely provided with a predominantly visceral-type of nerve supply?”
[This could be the explanation of why disc pain is often chronic and requires more treatment than does pain arising from other musculoskeletal tissues]