

The prevalence of lumbar spinal stenosis increases with age, and is approximately 19.4% among individuals aged 60-69 years old (442,452). Nonetheless, it may develop earlier due to injury or congenital factors (442). The rate of progression over time is variable, and may not always exhibit symptoms. Some studies report that approximately half of patients remain clinically stable, while a quarter worsen or improve (399,453,454). The symptoms of spinal stenosis may significantly affect patients' mobility, functional autonomy and performance in routine tasks (451).

The pathophysiologic mechanism is similar to disc herniation, even though the mechanical component is more significant with narrowing of the spinal canal or the intervertebral foramen resulting in either neurogenic claudication or radiculitis. Epidural injections have been shown to be effective in managing lumbar spinal stenosis in multiple RCTs and systematic reviews (7,55,58,60,65,70,77,81,83). In addition, spinal stenosis patients have been shown to respond to percutaneous adhesiolysis (72-74).

5.1.3 Lumbar Post-surgery Syndrome

Pain and disability in the low back and lower extremities following lumbar spine surgery has been hypothesized to be secondary to multiple causes including epidural fibrosis, sacroiliac joint pain, disc herniation, discogenic pain, spinal stenosis, arachnoiditis, and facet joint pain, along with inappropriate surgery (7,72-74,221,228,265-267,269,277,455-477). Failed back surgery syndrome was defined by the International Association for the Study of Pain (IASP) as a phenomenon of persistent or recurrent pain, mainly in the lower back or legs, even after previously anatomically successful surgeries (478). The review of literature of recurrent pain after lumbar discectomy for lumbar disc herniation, in patients under the age of 70 years, showed frequent or recurrent leg pain in 5% to 36% of patients 2 years after the operation (477,479). Some literature also has shown occurrence rates variable from 10% to 40% (73,476,479,480). Even though the ongoing debate continues in reference to epidural fibrosis and its effect on multiple pain problems or lack thereof, debate continues without an end (458,459,460,481,482). Nevertheless, Ross et al (460) showed that patients with extensive epidural fibrosis were 3.2 times more likely to experience recurrent radicular pain than those with less scarring. Electrophysiological evidence of neurologic disturbances caused by peridural scar formation was shown in experimental studies (464). Various additional

abnormalities including mechanical tethering of nerve roots secondary to epidural fibrosis in the vertebral canal (465,466), disturbances in blood flow (467), and expression of proinflammatory cytokines causing irritation of exposed dorsal root ganglion and triggering painful responses have been described (468). In addition, osteopontin has been shown to play a major role in the formation of epidural fibrosis and a mark-up DRG response to peridural scar formation (461). Additional experimental evidence has implicated paraspinal muscle spasms, tail contracture, pain behaviors, tactile allodynia, epidural and perineural scarring, and nerve root adherence to the underlying discs and pedicle in animal models (469).

Wound healing after tissue injury involves 4 major coordinated and regulated steps: hemostasis, inflammation, proliferation, and remodeling. Different factors can interfere with these steps, causing improper or impaired wound healing (473). Central to this is an increased inflammatory response with recruitment of polymorphonuclear neutrophils to the injury site. These cells help in the clearance of pathogens and foreign particles, but also lead to tissue injury with generation of reactive oxygen species (ROS) (483), excessive migration of fibroblasts and collagen deposition. Thus, excessive scarring and adhesion formation occurs and can be exacerbated by pathological process such as infection, inflammation, and hematoma formation (484). Numerous strategies have been tested to reduce adhesion formation post spinal surgery; however, there have not been any therapeutic breakthroughs to achieve this goal (473).

Consequently, in post-lumbar surgery syndrome, a multitude of pathophysiologic bases have been described including recurrent disc herniation, scarring and entrapment of the nerve roots and discogenic pain. These can be addressed with epidural interventions, either with epidural injections or percutaneous adhesiolysis. Multiple RCTs and systematic reviews have been performed with caudal epidural injections, as well as percutaneous adhesiolysis in post-lumbar surgery syndrome (56,58,60,72-74).

5.2 Cervical Disc-Related Pathology, Spinal Stenosis, Post-Surgery Syndrome

Chronic, persistent neck and upper extremity pain and radicular pain may be secondary to disc herniation, discogenic pain, spondylosis, spinal stenosis, or post cervical surgery syndrome resulting in disc related pain with or without radiculitis.