Class IV Laser Therapy Treatment of Multifactorial Lumbar Stenosis With Low-Back and Leg Pain: A Case Report

By Daniel Knapp, DC
3982 Bee Ridge Rd., Bldg. H/H
Sarasota, FL, 34233
(941)-925-2211
knapplaser@gmail.com

Disclaimer:
Daniel Knapp, DC, is a representative and physician laser trainer for K-Laser USA, a supplier of Class IV therapeutic lasers. He is the University of Miami Miller School of Medicine Complementary and Integrative Department laser therapy consultant.

ABSTRACT

Objective: This case report is presented to offer a potential intervention strategy in the treatment of resistant chronic back and leg pain with multifactorial central and foraminal stenosis.

Clinical Features: A 77-year-old female with bilateral total knee replacement (TKR) and total hip replacement (THR) presented using a walker for gait assistance and in obvious distress. She reported constant pain levels of 3 to 10 out of 10, with sharp pain across the lower back, buttocks, and posterior hips. The symptoms originally began 9 months prior, following left THR. Five epidural steroid injections failed to significantly reduce pain levels. Oxycodone was minimally effective in reducing her pain. MRI revealed L4-5 grade 1 anterolisthesis, with moderate-to-severe right foramen stenosis, mild central stenosis, and L5-S1 disc protrusion abutting the thecal sac and right S1 nerve root, establishing multiple potential pain generators.

Intervention and Outcome: Initially, the only modality utilized was the K-laser 10d Class IV therapeutic laser. Dosage was set at 9 to 10 W, continuous wave and pulsed at variable frequencies from 2 to 10,000 Hz, for each 6-to-10-minute treatment session. A 400-to-900-cm^2 area of the lower lumbar and gluteal regions received 1,600 to 3,300 J total per treatment for a 1.8 to 8.2 average J/cm^2. Eleven treatments in a 9-week period resolved pain on the left side and reduced the pain scale report on the right side by 50%. Prone diversified-type manual manipulation of the bilateral SI restriction was performed on the 4th visit. Pre–adjustment pressure along the intended line of drive produced no pain referrals, and no extension of the lumbar spine was permitted. This treatment was reported as aggravating and discontinued at the patient's request. No other interventions were employed, and the patient was asked to increase physical activity as tolerated. Progressive reductions in pain allowed her to be more active, improving range of motion and general conditioning through adding activities of daily living that had been previously intolerable.

Conclusion: Class IV laser therapy may be a treatment option in patients with chronic multifactorial low-back pain, possibly allowing for earlier active intervention and return to ADLs. Natural history influence on improvement cannot be excluded as a contributory factor in symptom reduction in this case study. Since laser therapy was initiated 9 months post-injury with ongoing

symptoms, the amount of contribution is uncertain. More controlled studies with high-power laser therapy and significantly greater total doses than are possible with Class II and III lasers are necessary for a broader understanding of this emerging modality.

Key Indexing Terms: Laser therapy, low-back pain, intervertebral disc displacement, spinal stenosis

INTRODUCTION:

Lumbar stenosis is present when neural elements are compromised in the central canal, lateral recess, and/or neural foramen. The prevalence of lumbar stenosis in the general population predilection is 1.7% to 8%; the condition usually develops in the 5th to 6th decades of life. This is typically due to degenerative changes of the disc, bulges, herniations, hypertrophic facets, ligamentum flavum overgrowth or buckling, and/or spondylolisthesis. Other complicating factors can include scoliosis, kyphosis, infection, or pathological space-occupying lesions. The impairment of the nerve roots and cord is more common from decreased cerebrospinal fluid (CSF) flow, which is responsible for 60% of nutrition to these structures, not frank compression.

Decompression surgery is considered the gold standard of care.[1] Typical symptoms include pain, numbness, and paresthesias in the posterolateral thighs and legs, radiating distally in dermatomal distribution, along with leg heaviness. Prolonged walking or sitting are often aggravating, with pain relieved by sitting and bending forward. Soft-tissue and bony hypertrophy contribute to thecal sac compression, as can degenerative spondylolisthesis, which is most common at L4/5 and can encroach on the L5 nerve root.[2]

This condition is seen routinely in the chiropractic practice with aging baby boomers and can present significant clinical challenges. Many patients will have already received extensive medical care, including OTC medication, NSAIDs, pain-relief medications, physical therapy, epidural steroid injections (ESIs), and/or decompressive surgery. Spinal manipulative procedures, soft-tissue techniques, physical therapy modalities, acupuncture, nutritional supplements, and stabilization exercises encompass the typical chiropractic treatment regimen.

Literature review produces conflicting evidence on chiropractic care of chronic low-back pain. Many studies are available on chiropractic management of chronic back pain, but there are limited studies of spinal stenosis, although they show potential benefit.[3] Chronic back pain studies often show mixed results. A 2004 Cochrane Review reported spinal manipulative therapy was not superior to other standard treatments for patients with acute and chronic LBP.[4]

Certain types of manipulation, such as extension manipulation, can be contraindicated in the stenosis patient since this positioning has shown on MRI to further narrow spinal canal diameter.[5] A McKenzie-type approach to loading response can help to rule in or rule out manipulation directional strategies and assist in outcome assessment. Centralization of symptoms secondary to care correlates with improved extension ROM.[6] Evans notes in his explanation of the Kemp's Test that a positive response for nerve root involvement in elderly patients is more likely to be secondary to degenerative joint disease, exostoses, inflammatory or fibrotic residues, narrowing from disc degeneration, or tumors, rather than disc herniation.[7] Decreasing inflammation of sensitized nociceptors of periarticular soft tissues, as well as innervated subchondral bone exposed by overlying cartilage erosion, may offer new pain-relief strategies.[8]

Limited studies have been published on LBP and laser. Two separate papers have shown combined laser therapy and exercise to be more effective than exercise alone.[9,10] A 2008 Cochrane review of low-level laser therapy and nonspecific back pain showed there were insufficient data to draw firm conclusions.[11] This paper was challenged in 2008 by Bjordal[12] and reported to the contrary by Unlu.[13]

CASE REPORT:

A 77-year-old female in obvious distress sought chiropractic care. She presented with a kyphotic posture and using a walker for ambulation to unload the back. She was unable to stand without assistance. At the time of examination, she reported constant pain levels from 3 to 10 out of 10 (worst possible pain), with sharp pain in the lower back, buttocks, and posterior hips. Aggravating factors included quick movements and sitting for longer than one hour. Improving factors included lying down.

The complaints originally began upon awakening from a left total hip replacement (THR) surgery 9 months prior. She was referred to an orthopedic back specialist, who felt she was a non-surgical case and referred her for physical therapy. Physical therapy was discontinued after 4 weeks because of worsening symptoms. The patient was then referred to an anesthesiologist/pain management specialist. Prior care included five epidural steroid injections and oral Oxycodone, which offered a very limited reduction in pain. The patient discontinued the oral medication several months before time of examination because of intolerable side effects and fear of falling.

Pain levels had progressively returned to immediate post-THR levels at time of intake. Palpation revealed paralumbar hypertonicity and tenderness, and multiple gluteal trigger points without referral. SI joints were reported tender, and posterior-to-anterior restriction was evident on motion palpation. Lumbar extension was 5 degrees, with increased back and gluteal complaints increasing on repetitions, flexion 70 degrees, repetitions partially improving complaints. No focal reflex, focal motor, or sensory changes were noted.

Kemp's was positive for increasing lumbosacral/gluteal/posterior thigh pain, sitting root negative, and SI compression was positive for local pain bilateral. MRI revealed L4-5 grade 1 anterolisthesis with prominent bulge or protrusion, osteophytes, and facet DJD creating moderate to severe right foramen stenosis, mild central stenosis, and L5-S1 disc protrusion abutting the thecal sac and right S1 nerve root.

A diagnosis of symptomatic lumbar foraminal and central stenosis and bilateral sacroiliac joint restriction was given. The percentage contribution of SI dysfunction, disc protrusion vs. degenerative decreased foramen and canal diameter, could not be established. This is often encountered in complex multifactorial back pain so common in the elderly, especially in the absence of definite neurological findings. Prior partial response to ESIs possibly suggests central spine involvement. Worsening of symptoms and failure to significantly improve with prior modalities establishes multiple potential pain generators and case management complexity.

The initial goal of the treatment plan was to decrease chronic inflammation/irritation of deep and superficial lumbar nociceptors that had possibly become sensitized from ongoing stimulation. The plan was to improve pain-induced deconditioning and ADL intolerance, opening the door for more active intervention. Aerobic conditioning was limited by prior bilateral total knee replacement (TKR) and THR surgeries.

Treatment consisted of the K-laser 10d, GaAS/GaAlAs dual 790 nm and 970 nm laser (K-laserUSA, 311 Royal Oaks Blvd, Suite 140-A, Franklin, TN 37064, www.k-laserusa.com)

as the sole intervention at 9 to 10 W, pulsed, variable frequencies, 6 to 10 minutes, over a 400-to-900 cm^2 area, 1,600 to 3,300 J total per treatment dosage. The treatment was applied twice in the first week, followed by one treatment a week for 9 weeks. This resulted in pain elimination on the left side and 50% pain reduction on the right side.

Care was interrupted, with a 2-month follow-up revealing retained left-side benefits and 75% improvement on the right. Improvements were noted in walking and in increased sitting tolerance. Complaints at the time of writing include complete retained resolution of left-side pain, intermittent ache, and infrequent sharp pain in the right lower buttock with quick movements. The patient could stand at the sink to prepare meals and was able to return to more outdoor activities, establishing sustained benefits of care.

DISCUSSION:

Lasers work by using an energy source that directs photons into a resonance chamber containing a medium (e.g., GaAl, HeNe). This will stimulate the medium, driving electrons to a higher energy state. Upon return to ground state, energy is released in the form of a photon with an identical wavelength. If enough photons are pumped into the medium, high-energy-state electron population inversion occurs, and the incident photon is not lost. Consequently, two identical photons are produced, and eventually a large number of same-wavelength (e.g., 790 nm) photons are concentrated in the lasing chamber. Reflective and partially reflective mirrors allow a percentage of photons to escape in the form of a beam and others to remain in the chamber to continue the population inversion process.[14] Current Class IV therapeutic lasers reach up to 12 W of continuous wave power.

Lasers have unique wavelengths, which are absorbed by tissues differently. All exhibit the unique qualities of monochronicity and coherence or the ability of light waves to travel in parallel and phase to give laser energy direction and penetration. In multiple studies, therapeutic lasers have been shown to promote musculoskeletal tissue healing.[15]

Laser therapy promotes healing from a variety of mechanisms known as laser photobiomodulation by photon absorption at a cellular level by photoreceptors or chromophores. The anti-inflammatory properties of therapeutic laser have been shown to follow multiple pathways. These include the cytokines tumor necrosis factor (TNFalpha), IL1-beta, IL-6, and prostaglandin E2. Albertini[16] recently studied cytokine mRNA expression and modification in induced inflammation of rat paws. Treatment included laser irradiation at 660 and 684 nm with a dose of 7.5 J/cm^2. Both groups had 30% to 40% lower mRNA for the above cytokines than controls 3 hours after treatment. Aimbire[17, 18] also revealed TNFalpha reductions with GaAlAs lasers in animal studies using 5.2 J/cm^2 energy density. Bjordal[19] also published findings of decreased prostaglandin E2 with a 904 nm laser on human Achilles tendinitis at 5.4 J/point and a power density of 20mW/cm^2.

The antioxidative and cytoprotective role of therapeutic laser is a common focus of study. Anvi[20] and Liveira,[21] among others, have shown this by various mechanisms, including activation of antioxidants, cytoprotective proteins, and cytochrome c oxidase by GaAs 810 nm and 904 nm therapeutic laser stimulation. The effect of high-dose laser therapy on surgically induced disc injuries in a rat model resulted in a "remarkable increase in disc regeneration and healing following trauma."[22]

Bjordal's recent review of literature on low-back pain found statistically significant improvement in nonspecific low-back pain patients treated with laser therapy, except in studies with too low a dose.[23]

CONCLUSION:

Laser therapy may have influenced the inflammatory and pain reduction parameters of this case. One cannot exclude the improvement

contribution from natural history. Class IV laser therapy may be a low-back pain treatment option for patients with untreated chronic low-back pain or for those who don't respond to medical treatment. More controlled studies with Class IV high-power therapeutic lasers and greater total doses than Class II and III lasers are necessary for a broader exposure and understanding of the expanding use of laser therapy and effective dosage ranges.

Consent:
Written informed consent was given for the anonymous use and publication of all clinical information, including imaging studies relating to this paper.■

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