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Review Article

Should anyone perform percutaneous endoscopic laser diskectomy and percutaneous lumbar disc decompressions?

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Abstract

Background: Increasingly, pain management specialists (P-S) (e.g., anesthesiologists, radiologists, or physiatrists), who are not spinal surgeons, are performing percutaneous endoscopic laser diskectomy (PELD), percutaneous lumbar disc decompression (PLDD), and target percutaneous laser disc decompression (T-PLDD) in patients with minimal/mild disc herniations. Here, theoretically, the laser vaporizes/shrinks a small portion of disc tissue that lowers intradiscal pressure/volume, and thereby provides "symptomatic relief" (e.g., low back pain/radiculopathy). Nevertheless, the vast majority of these patients experience spontaneous relief of their complaints over several months without any intervention.

Methods: A literature review revealed that P-S specialists are performing PELD/PLDD/T-PLDD to address minimal/mild disc herniations. However, multiple well-designed studies confirmed that PELD/PLDD/T-PLDD were ineffective for managing acute/chronic pain in these patients.

Results: Several randomized clinical trials documented the lack of clinical efficacy of PELD/PLDD/T-PLLD procedures over microdiskectomy. PELD/PLDD/T-PLDD correlated with only 60–70% success rates with higher reoperation rates (e.g., up to 38%) vs. 90% success rates for routine microdiskectomy (e.g., with faster recovery and only 16% reoperation rates). Nevertheless, without surgical training, P-S are performing these procedures and are , therefore, unable to adddress perioperative/postoperative PELD/PLDD/T-PLDD surgical complications.

Conclusions: Pain management specialists, who are not trained spinal surgeons, should not perform PELD/PLDD/T-PLDD surgery to treat minimal/mild disc herniations. Not only do most of these discs resolve spontaneously over several months but also they are largely ineffective. Furthermore, there is no evidence to support the superiority of PELD/PLDD/T-PLDD procedures over microdiskectomy even if performed by spinal specialists.

Key Words: Pain management specialists: Not surgeons, percutaneous lumbar endoscopic diskectomy, spinal surgery

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INTRODUCTION

Should pain management specialists (P-S) (e.g., anesthesiologists, radiologists, and physiatrists), who are not spinal surgeons, perform percutaneous endoscopic laser discectomy (PELD), percutaneous lumbar disc decompression (PLDD), and target percutaneous laser disc decompression (T-PLDD) for minimal/mild disc herniations? Here, in theory, the laser vaporizes/shrinks a small portion of disc tissue that lowers the intradiscal pressure/volume, and provides "symptomatic relief" of low back pain/radiculopathy. However, the natural history for these minimal/mild disc hernations is that the vast majority spontaneously resolve over several months without any intervention. Furthermore, when "surgery" is indicated, several well-designed studies have shown that PELD/PLDD/T-PLDD are ineffective in the management of acute/chronic pain in patients with minimal/mild lumbar disc herniations and have lower success rates (60–70%) and higher reoperation rates (38%) vs. routine microdiskectomy [e.g., 90% success rates/faster recovery rates and fewer reoperations (16% rates)].

Natural history of lumbar disc herniations: The majority spontaneously improve

Many patients with unilateral radiculopathy due to minimal/mild disc bulges experience spontaneous clinical/radiographic [magnetic resonance (MR)-documented] improvement of their discopathy/radiculopathy without PELD/PLDD/T-PLDD.[3,9] In a study by Komori *et al.*, most symptomatic lumbar disc herniations (100% radiculopathy 94% SLR positive, 32% motor deficits) spontaneously regressed (e.g., without surgery) on sequential MR studies performed over an average interval of 150 days.[9] Later, Casey *et al.* stated that "most cases of radiculopathy were self-limiting, and symptoms resolved over the course of weeks to months."[3]

Pain management specialists perform percutaneous injections, including epidural spinal injections, but are not spinal surgeons

In a commentary in 2013, Epstein noted that P-S perform multiple unnecessary epidural spinal injections (ESI) that are "typically short-acting and ineffective over the longer-term."[6] Reports of contaminated ESI from the Center for Disease Control (CDC) in 2012/2013 documented "25 deaths (many due to Aspergillosis), while 337 patients sickened, and 14,000 were exposed to contaminated steroids." Additional morbidity/mortality attributed to ESI included "spinal fluid leaks (0.4–6%), positional headaches (28%), adhesive arachnoiditis (6–16%), hydrocephalus, air embolism, urinary retention, allergic reactions, intravascular injections (7.9–11.6%), stroke, blindness, neurological deficits/paralysis, hematomas, seizures, and death."[6] Although, P-S have experience with various percutaneous injection techniques/ESI/rhizotomies), they are not spinal surgeons (e.g., did not complete neurosurgical/orthopedic residency training programs), and are, therefore, not adequately trained to perform spinal surgery.

"Pros" for PELD/PLDD/T-PLDD based on studies without clinical control groups or independent observers

Several poorly designed studies without clinical control groups or independent observers, documented the safety/efficacy/outcomes of PELD/PLDD/T-PLDD [Tables 1 and 2].[4,8,10,11,13,16,17] In 2004, Sobieraj *et al.* evaluated the clinical efficacy of 212 PLDD performed for lumbar pain/radiculopathy; although 79.2% experienced a reduction in pain over the first 6 postoperative weeks, 3.8% deteriorated due to "inflammation" [Table 2].[16] Interestingly, the authors concluded that PLDD were appropriate for only "slight" herniated discs, but should only be performed as a "last attempt" for those with larger disc herniations, and only if the posterior longitudinal ligament (PLL) was intact. Maksymowicz *et al.*, in 2004, noted that PLDD through "vaporization and ablation of a small amount of tissue from the nucleus pulposus" could reduce intradiscal pressure and root compression (e.g., typically without confirmation of either result), relieving 75% of the symptoms [Table 2].[11] Notable contraindication to PLDD included sequestrated discs, underlying coagulopathies, and bacterial infection. In 2007, Ishiwata *et al.* documented a 68.8% success rate for MR imaging-guided laser-tip PLDD performed for 32 patients (average age of 35 years) with back pain/monoradiculopathy without neurological deficits [Table 2].[8] In 2011, Lee and Lee utilized the carbon dioxide (CO_2) laser to perform microdiskectomies (average age of 62.2 years) at the L5-S1 level; immediately postoperatively; 27 of 28 patients improved (e.g., 1 transient dysesthesia), one year later, average VAS/ODI scores decreased significantly, and they declared "clinical success" in 27 patients (96.4%), none of who required secondary surgery or fusions [Table 2].[10] In 2012, Zhao *et al.* utilized C-arm fluoroscopy to perform 25 PLDD using the Nd:YAG laser; success rates were 92.0% and 92.0% (MacNab's criteria) at 6 and 12 months, respectively, and there were no complications [Table 1].[17] The authors concluded that "T-PLDD can significantly decrease pain and improve function of patients who have extruded but nonsequestered lumbar intervertebral disc herniations."[17] Over a 3 year period, Ren *et al.* (2013) performed 80 PLDD in 42 patients utilizing the Nd:YAG laser in two age groups (Group I: 19 patients ≤45 years old, and Group II: 23 patients >45 years old) [Table 1].[13] Outcomes were similar for both age groups at 3–36 postoperative months, and there were complications. Notably, none of these series included control groups or independent observers to validate their extraordinarily positive conclusions.

Table 1: Summary of laser diskectomy literature (2012-2015)

Reference Year Author	Procedure/Surgery Aim of Study	Results of PELD	Conclusion
Brouwer *et al*.[2] 2015	115 disc herniation/sciatica <1/3 Spinal canal dimension PLDD (57 patients) vs. conventional microdiskectomy (58 patients) Randomized, prospective trial	RDQ noninferiority of PLDD at 8 and 52 weeks vs. conventional surgery PLLD faster recovery	Reoperations More 38% PLDD vs. 16% conventional surgery group (16%)
Ren L *et al*.[14] 2013	Postoperative imaging of laser PLDD-22 patients Hypothesis: PLLD promotes reduction in disc herniation in both cervical and lumbar spine	PLDD did not obviously lower the height of the intervertebral space, but promoted reduction of disc herniation	PLDD is a safe and effective MIS in cervical and lumbar disc diseases
Singh *et al*.[15] 2013	PELD update-efficacy A systematic review	Limited evidence for percutaneous lumbar laser disc PELD decompression	Although PELD has been used for many years, there is a paucity of randomized clinical trials
Ren L *et al*.[13] 2013	PLDD lumbar decompression-efficacy; 25 patients Nd: YAG over 3 postoperative years: 80 discs/42 patients Group I: 19≥45 years old Group II: > 45 years old 8042 p E Clini	Improved outcomes significantly at 3 months-maintained higher level 3 years. Favorable outcomes: 45.24% at one month and 66.67% at 3 months	Efficacy of PLDD is fairly good for both selected younger and older patients. No complications in 80 levels/42 patients Same outcomes in both age groups of 3-36 months
Zhao[17] 2012	25 T-PLDD (lumbar discs C-arm fluoroscopy	PLD significantly decreased pain-improved function extruded nonsequestered lumbar discs	Documented efficacy of T-PLDD MacNab's Criteria Success 92.0% at 1 year
Draper *et al*.[5] 2012	36 dogs-acute paraparesis Plegia-disc herniations Control group (1) Laser treatment group (2)	Dogs in Group 2 were treated postoperatively with low-level laser therapy daily for five days	Low-level laser therapy with surgery reduced time to ambulation T3-L3 myelopathy

PLDD: Percutaneous Laser Disc Decompression, T-PLDD: Target PLDD, MR: Magnetic Resonance Imaging, PELD: Percutaneous Endoscopic Laser Diskectomy, DL: Dorsolateral, LDH: Lumbar Disc Herniation, LLT: Low-Level Laser Therapy, EFLDH: Extraforaminal Lumbar Disc Herniation, ODI: Os westry Disability Index, rLDH: Recurrent Lumbar Disc Herniation, CO2: Carbon Dioxide Laser, RDQ: Roland-Morris Disability Questionnaire

Treatment with PLDD fails to demonstrate loss of disc height on radiographic studies

Ren *et al*. evaluated the medium-term results of neuroradiological imaging following 22 PLDD, looking for confirmation of loss of disc height [Table 1].[14] They found that although "PLDD did not obviously lower the height of the intervertebral space, instead it could effectively promote the reduction of disc herniation."

"Cons," including lack of efficacy, of PELD/PLDD/T-PLDD substantiated in multiple well-designed prospective randomized trials

Multiple prospective randomized trials documented the lack of efficacy of PELD/PLDD/T-PLDD alone or compared with microdiskectomy.[2,7,12,15] In 2007, Goupille *et al*. looked at multiple PELD/PLDD studies (1980–2006) in the MEDLINE EMBASE databases [Table 2].[7] They found no uniformity in the technical performance of these procedures due to the "lack of control studies," and concluded that "this treatment cannot be considered validated for disc herniation-associated radiculopathy resistant to medical treatment" [Table 2].[7] In a randomized controlled trial, Postacchini and Postacchini noted transforaminal endoscopic diskectomy yielded comparable results vs. routine microdiskectomy, as long as the "surgeon is expert enough in the technique, which implies a long learning curve in order to perform the operation effectively, with no complications" [Table 2].[12] However, they noted that the "success rate ranges from 60 to 70% for the former vs. 90% seen with microdiskectomy." Utilizing multiple major databases, Singh *et al*. looked at the efficacy of PELD in treating lumbar discs/radiculopathy [Table 1].[15] They concluded "although laser diskectomy has been utilized for many years, there is a paucity of randomized clinical trials," and therefore, "this systematic review shows limited evidence to support the use of percutaneous lumbar laser disc decompression." Brouwer *et al*., in 2015, in a randomized/prospective trial of 115 patients with sciatica/lumbar discs (8 hospitals in the Netherlands) occupying less than one-third of the spinal canal, performed PLDD (57 patients) (FDA approved 1991) vs. routine microdiskectomy (58 patients) [Table 1].[2] Although the Roland-Morris Disability Questionnaire (RDQ) "showed non-inferiority (e.g., not worse) of PLDD at 8 and 52 weeks" vs. conventional surgery, those undergoing microdiskectomy recovered more quickly and required fewer reoperations (38% PLDD versus 16% microdiskectomy).

Table 2: Summary of laser diskectomy literature (2004-2011)

Reference Year Author	Procedure/Surgery Aim of Study	Results of PELD	Conclusion
Lee *et al*.[10] 2011	31 consecutive patients EFLDH a t L5S1 Carbon dioxide (CO_2) laser-assisted microdiskectomy for extraforaminal lumbar disc herniation at the L5-S1 level-lateral transmuscular route	This technique may not effectively remove foraminal lumbar disc herniation (FLDH), resulting in persistent leg pain and need for revision surgery	Satisfactory surgical results at the 1-year follow-up
Postacchini *et al*.[12] 2011	Microdiskectomy: 90% effective Laser discectomy: 60 to 70% effective	Faster recovery Lower reoperation rate with microdiskectomy	60–70% success with laser discectomy-longer recovery
Ay *et al*.[1] 2010	Compared effectiveness of low-level laser therapy (LLLT) on pain/function for acute and chronic lumbar disk herniation (LDH). Random assignments: Hot Pack/Laser Group 1 (acute LDH, $n=20$) Group 2 (chronic LDH, $n=20$) Hot Pack/Placebo Group 3; (acute LDH, $n=20$) Group 4: (chronic LDH, $n=20$)	15 Sessions; 3 weeks No significant differences between 4 groups Same outcomes	No differences between laser and placebo on pain severity and functional capacity for acute and chronic disc herniations
Ishiwata *et al*.[8] 2007	MR guided PELD relationship between clinical results and needle tip location Single-level contained focal disk herniation	Success: 27 patients with needle tip in DL quadrant; 70.4%. 14 patients with needle tip in middle zone showed a favorable outcome (77.8%)	Middle zone in the DL quadrant of the targeted disk space Favorable target -better outcomes. Overall success rate PLDD 68.8%
Maksymowicaz *et al*.[11] 2004	PLDD Vaporization and ablation of small amount of tissue from the nucleus pulposus. Significant reduction in pressure in disc (closed space)	PLDD effective in 75% of low back pain reduction of symptoms	One-stage Treatment-multi level discs Contraindications for PLDD: Sequestrated disc Coagulation abnormality Infection
Sobieraj *et al*.[16] 2004	Prospective PLDD in 212 patients with discopathic lumbar pain. PLDD is not an alternative to open surgery-different classifications (e.g., PLLD more minimal discs)	PLDD: 79.2% resolution or significant reduction of pain PLDD last attempt MIS if no disruption posterior longitudinal ligament	PLDD is not an alternative to open surgery on lumbar discopathy

PLDD: Percutaneous Laser Disc Decompression, MR: Magnetic Resonance Imaging, PELD: Percutaneous Endoscopic Laser Diskectomy, DL: Dorsolateral, LDH: Lumbar Disc Herniation, LLT: Low-Level Laser Therapy, EFLDH: Extraforaminal Lumbar Disc Herniation

PELD/PLDD ineffective in managing acute/chronic pain in a clinical randomized double blind placebo-controlled trial versus experimental dog model

In a randomized, double blind, placebo-controlled trial, Ay *et al*. determined that low-level laser therapy (LLT) proved of no benefit (was ineffective) for patients with acute/chronic pain attributed to lumbar disc herniations (LDH) [Table 2].[1] In this study, 4 groups of patients (20 patients per group) with LDH were treated for 15 sessions over a 3-week period; Group 1 (acute) and Group 2 (chronic) patients both received hot-pack/laser therapy; Group 3 (acute) and Group 4 (chronic) patients both received hot-pack/placebo laser therapy. Notably, all patients demonstrated comparable outcomes, and "there were no differences between laser and placebo laser treatments on pain severity and functional capacity in patients with acute and chronic low back pain caused by LDH." Unlike the clinical experience, when Draper *et al*. studied 36 dogs with acute paraparesis caused by disc herniations, following disc resection, those dogs undergoing additional low level postoperative laser therapy ambulated sooner [Table 1].[5]

SUMMARY

Pain management specialists, who are not spinal surgeons, are increasingly performing PELD/PLDD/T-PLDD operations for minimal/minor lumbar disc herniations, which many contend, would resolve spontaneously over several months duration. Furthermore, the "pros" for these procedures comes from typically poorly designed clinical studies, without controls or independent evaluators.[4,8,10,11,13,16,17] Alternatively, the "cons" the (e.g., lack of efficacy of these PELD/PLDD/T-PLLD operations) against these procedures have been

well-established in multiple well-designed prospective randomized clinical trials [Tables 1 and 2].[1,2,7,10,12,15] We then ask, should pain management specialists or even spine surgeons perform PELD/PLDD/T-PLDD: What do you think?

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Conflicts of interest
There are no conflicts of interest.

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