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Twenty-three years of percutaneous laser disc decompression (PLDD) – State of the art and future prospects

Daniel S.J. Choy[a,*], Gian Paolo Tassi[b], Johannes Hellinger[c], Stefan Hellinger[c], Sang-Ho Lee[d]

[a]*Laser Spine Center, Columbia University, 66 E. 80th Street, New York, NY 10075, USA*
[b]*Casa Di Cura Villa Anna, Via Toscana 159, 63013 San Benedetto del Tronto (AP), Italy*
[c]*Isar Klinik, Windenmacherstr.2, 80333 Munich, Germany*
[d]*Wooridul Spine Hospital, 47-4 Chungdam-dong, Gangnam-Gu, Seoul 135-100, Republic of Korea*

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Abstract

In mid-February 1986, Peter Ascher and Daniel Choy performed the first percutaneous laser disc decompression (PLDD) at the Neurosurgical Department, University of Graz, Graz, Austria. It was planned to deliver 1000 J with a Nd:YAG laser to a herniated L4-L5 disc causing sciatica. At 600 J the procedure was terminated because the pain was gone.

Since then, PLDD has spread all over the world, with procedures being performed throughout the entire spine, with exception of T1-T4 because these discs do not permit percutaneous access with a needle. The success rate has ranged from 70% to 89%, and the complication rate, chiefly discitis, from 0.3% to 1.0%. When successful, the return to normal work is on average 1 week. The long-term follow-up of 23 years has yielded a recurrence rate of 5%.

Keywords: Laser; Disc; Decompression; Percutaneous; Herniation; Sciatica

Introduction

In mid-February 1986, Professor Peter Ascher, a neurosurgeon, and Daniel S.J. Choy, performed the first percutaneous laser disc decompression (PLDD) on a Turkish immigrant worker at the Neurosurgical Department, University of Graz, Graz, Austria. They had planned to deliver 1000 J with a Nd:YAG laser via a 16 G needle inserted into the L4-L5 disc. At 600 J, the patient exclaimed, "The pain is gone!". That first success was to be repeated many times, all over the world, for the next 23 years.

A first paper was published in the New England Journal of Medicine under the title of "Percutaneous laser nucleolysis of lumbar disks" in 1987 [1]. It came to the attention of A.A. White III, Chief Orthopedic Surgeon at Harvard. He was writing "Clinical Biomechanics of the Spine" [2], and invited Choy to contribute a short section on lasers for his textbook. During the course of telephone discussions, he suggested that a more precise description of our procedure was "decompression" rather than "nucleolysis." A.A. White III is therefore in part responsible for the term PLDD.

*Corresponding author. Tel.: +1 2125 356040; fax: +1 2125 173728.
E-mail address: dchoy@nyc.rr.com (D.S.J. Choy).

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Scientific rationale

The first human patient was preceded by 2 years of laboratory investigations at Prof. Robert Case's Investigative Cardiology Laboratory at St. Luke's Hospital, Columbia University with fresh cadaver spines (less than 48 h old), bovine spines, 19 live canine subjects, a special frame designed by Daniel S.J. Choy, and a Nd:YAG laser (Messerschmitt-Bölkow-Blohm GmbH, (MBB)). The following basic biomechanical data were developed:

1. The intact intervertebral disc is an enclosed hydraulic space consisting of superior and inferior endplates that are essentially unyielding, encircled by the annulus, a complex lamellar ring of semi-elastic collagen fibers, and a hydrogel core of proteoglycan material with varying amounts of water, decreasing with increasing age (75–80% at age 40 and 50–60% in octogenarians).
2. A volume change of 1 ml is associated with a 312 kPa change in intradiscal pressure (Fig. 1).
3. Intradiscal pressure which has increased to a steady state, falls sharply with intradiscal laser vaporization of 200 mm^3 of water in the intact disc (Fig. 2).
4. This fall of intradiscal pressure occurred *in vivo* with intradiscal application of 1000 J with a Nd:YAG laser (Fig. 3). Such application of intradiscal laser energy resulted in no significant rise of temperature in adjacent structures such as the annulus.
5. Percutaneous application of 1000 J Nd:YAG laser energy into the L4-L5 disc of anesthetized canine subjects resulted in a slight limp in 1 of 19 subjects. Necropsy of the 19 subjects at 10 days revealed olive-shaped lesions measuring 10 mm × 4 mm in the targeted discs (Fig. 4).

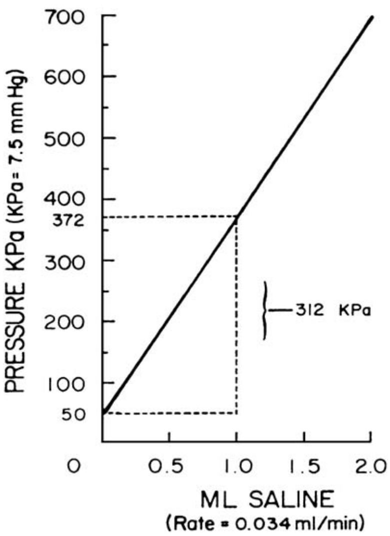

Fig. 1. Graph plotting intradiscal pressure versus volume of saline infused. This is 312 kPa per ml of saline infused.

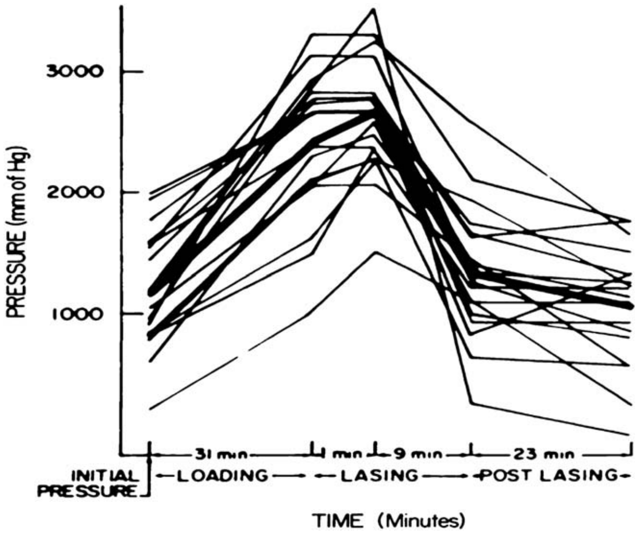

Fig. 2. Plot of a loading phase with a preload pressure of 2419 mmHg, a stabilized after-loading pressure, against the fall of pressure in the 9 min of lasing, and the continued fall in pressure during 23 min after lasing with stabilization at the end. The total fall of intradiscal pressure with laser ablation = 1344 ± 601 mmHg or 55.6% ($p < 0.0001$).

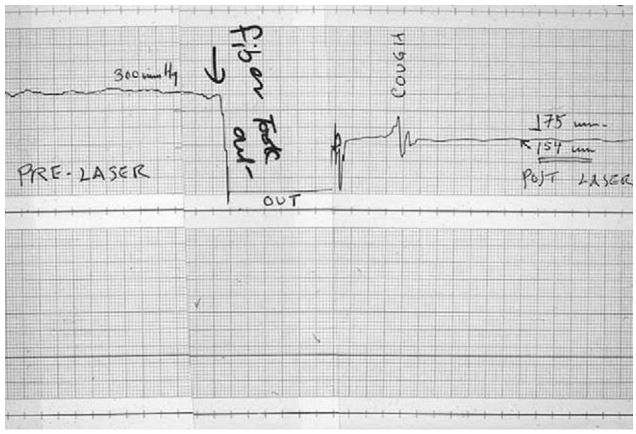

Fig. 3. Pre- and post-PLDD intradiscal pressures, with handwritten notes. There is a fall from 300 to 154 mmHg. The "glitch" caused by a cough, demonstrates open manometrics.

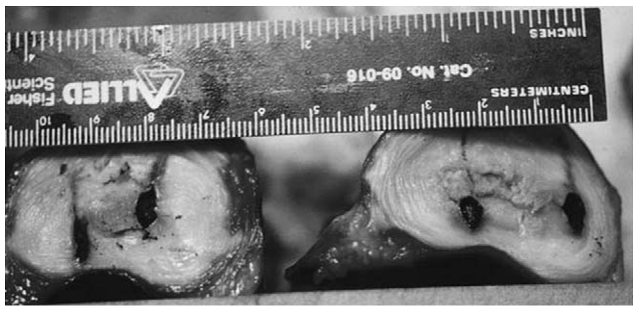

Fig. 4. Laser tracts formed in nucleus pulposus by 1000 J of laser energy at a 1320 nm on the left, and a 1060 nm Nd:YAG laser on the right.

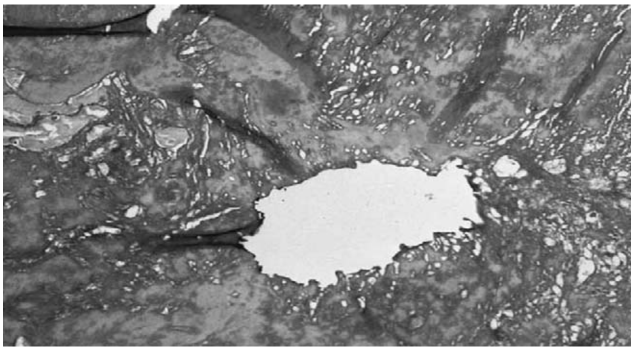

Fig. 5. Histologic appearance of a laser tract in the nucleus pulposus. There is a central hole surrounded by a zone of protein denaturation and then vacuoles, which are probably steam pockets.

6. Histological examination disclosed a thin ring of carbonization surrounded by a zone of protein coagulation, and bordered by a narrow zone of vacuolization interpreted as pockets of steam (Fig. 5).

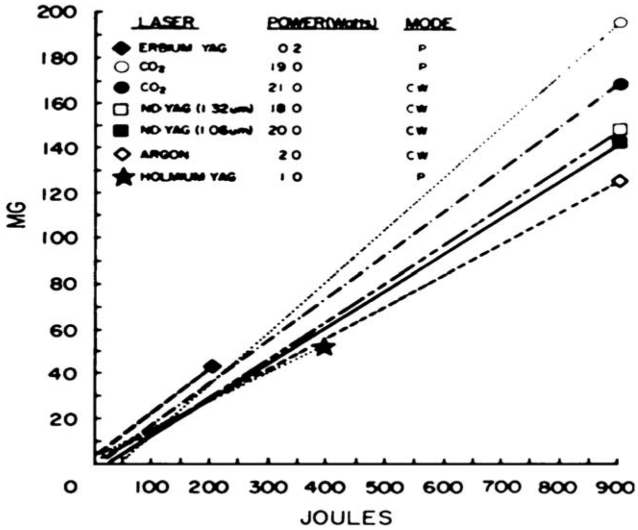

Fig. 6. Composite graph of various wavelengths versus mass of disc ablated. The CO_2 in the pulsed (P) mode is the most efficient, and the least efficient is the argon in a continuous wave (cw) mode. The potassium triphosphide (KTP) wavelength is close to that of the argon laser.

PLDD procedure

Choice of fiber and needle

Our next decision concerned the delivery system: the needle and the optical fiber. In general, the candidates for the needle were a 16, and 18, and a 20 G, all with a trocar. For safety in use, in the proximity of nerve roots, it was decided to substitute a conical pencil tip for the usual cutting tip. The 20 G needle was too flexible to permit sufficient hand control, which left the 16 and 18 G needles to choose from. Since a 400 μm fiber would fit nicely in the 18 G needle and still leave sufficient room for vaporized gases to escape, and the needle was sufficiently stiff to permit good hand control, this needle was chosen over the 16 G needle. The larger bore needle was considered to be more invasive than its thinner counterpart. The relative diameters of the needles will be the subject of discussion later in this paper. The original optical fiber available to us was of glass core–plastic sheath construction. The plastic sheath had a low melting point and many experiments were ruined by fiber "burn-back." We eventually found a glass–glass fiber with a higher melting point and an outer diameter (o.d.) of 400 μm that has been in clinical use ever since.

Choice of laser

Dr. Steven Trokel's laboratory at the Eye Institute, Columbia University, in 1990 had an array of lasers including the CO_2, the Er:YAG, two Nd:YAGs at 1320 and 1060 nm, the argon, and an early model of the Ho:YAG. Our group was invited to perform a comparison study with fresh human cadaver discs as the target tissue. We found the greatest efficiency in the Er:YAG, and in descending order: CO_2 continuous wave (cw) and pulse mode, Nd:YAG 1320 nm, Nd:YAG 1060 nm, argon, and Ho:YAG (Fig. 6). However, the data on the last laser were unreliable since this was an early model.

Modern Ho:YAG lasers have a much higher energy in water than the Nd:YAG. Although this provides the Ho:YAG laser an advantage in the physics laboratory, it is disadvantageous in the operating room, as we shall see.

Needle placement

Having selected the needle (an 18 G with a conical tip trocar), an optical fiber (a glass–glass fiber with 400 μm o.d.), and a laser (a Nd:YAG 1060 nm), we ascertained that 1000 J applied to the disc nucleus would produce an elliptical lesion measuring 10 mm × 3–4 mm in diameter at its widest point, and next had to determine the optimal geometry of needle placement. It was determined that the needle's axis should be parallel to the target disc axis, aimed at the middle of the disc, with the needle point just inside, or past the annulus, and with the optical fiber not protruding more than 1.0 cm past the needle point (a fiber has been designed with a proximal stopper to maintain this geometry). A laser tract caused by delivery of 1000 J would be created as far as possible from the opposite annulus, and equidistant from the superior and inferior endplates, and still leads to at least a 50% fall of intradiscal pressure. A correct needle placement such as this can be achieved by the use of biplane fluoroscopy alone (Figs. 7 and 8).

These data have been extensively reported in numerous peer-reviewed papers [2–12] and in at least two textbooks [13].

Based on these data, we postulated that it might be possible to introduce laser energy into the nucleus of a herniated disc to vaporize enough intradiscal water leading to a negative change in pressure, causing shrinkage of the herniation away from the nerve root into the "parent" disc.

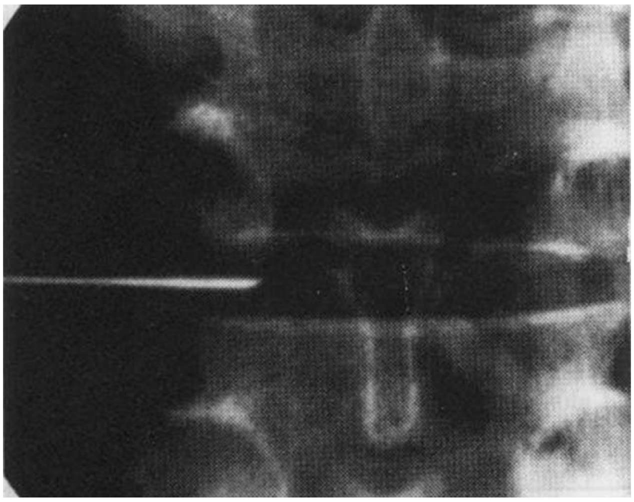

Fig. 7. Anteroposterior (AP) view of the correct needle placement. The needle is midway between the two endplates, is parallel to the disc axis, and the point is just past the annulus.

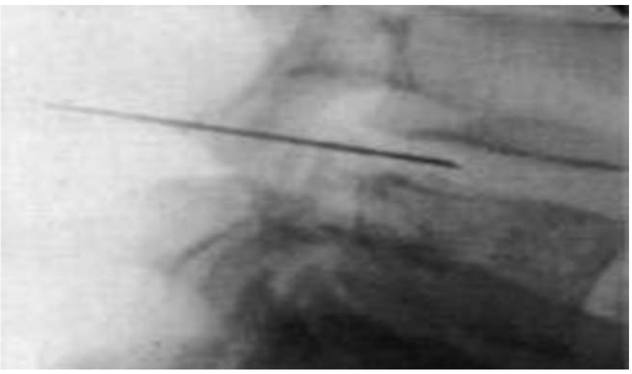

Fig. 8. Lateral view of correct needle placement. The needle is midway between the two endplates, parallel to the disc axis, and the point is just past the annulus.

Pursuing this reasoning further, a fall in intradiscal pressure is uniform throughout the disc. Hence, in practice, it is not necessary to select a specific point in the nucleus to apply the laser energy.

The techniques of PLDD using the Nd:YAG laser can be found in detail in [13].

Patient selection and medical indications for PLDD

In the last 23 years, PLDD has spread worldwide and is being routinely performed in all of Western Europe, the United States, Central and South America, China, Japan, India, and Korea.

In the beginning, we elected to only perform PLDD on uncomplicated cases. When testing a new technique, it is always best to keep things simple, in order to make necessary corrections without the complication of many factors. Therefore we only chose patients who had clearly documented non-extruded disc herniations accompanied by radicular pain, where at least 6–8 weeks of conservative therapy had failed.

Nowadays, there is a tendency among the less experienced laser surgeons to place excessive reliance on MRI findings. But some points should be taken into account.

Every MRI of the spine performed to diagnose disc herniation is performed in the *supine position.* Over 30 years ago, Nachemson [14] found intradisc pressure of the L4-L5 disc to be 15–25, 100, and 150 kPa in the supine, standing, and sitting positions. Jolecz [15] demonstrated marked increase of an L5-S1 disc protrusion imaged with a "sitting" MRI, compared with an MRI taken in the usual supine position (Figs. 9 and 10). The sitting MRI is seen in Fig. 11.

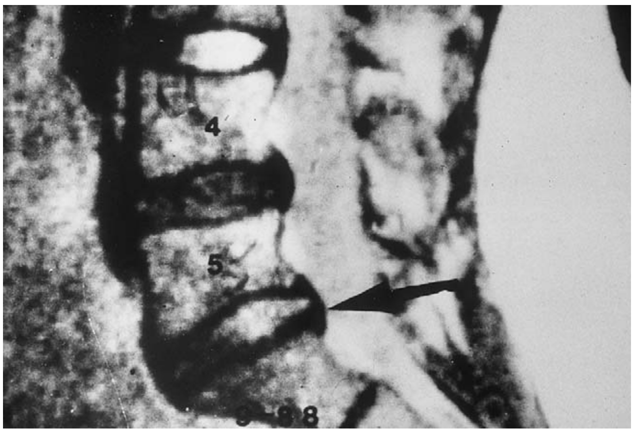

Fig. 9. Magnetic resonance (MR) image of L5-S1 showing a mild bulge.

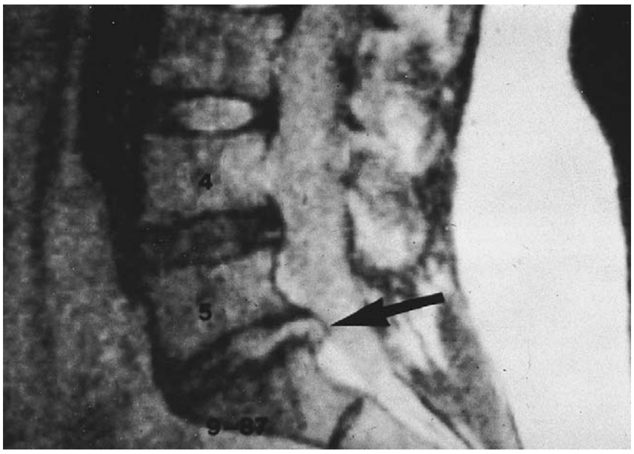

Fig. 10. Increased protrusion of the L5-S1 disc imaged with a "sitting" MRI.

Fig. 11. The patient in the *sitting* magnetic resonance imaging (MRI) machine, where the image in Fig. 10 was taken.

Fig. 12. Choy compression frame.

Since the GE sitting MRI cost $5,000,000 at that time, Choy et al. [16] invented a compression frame (Fig. 12) with which supine MRIs of the spine can be taken with lumbar disc pressures increased to 150 kPa. As a rule we place 75% reliance on history and neurological findings and only 25% on MRI findings in patient selection for PLDD.

Dr. Steven Joffe arranged for yearly tutorials at the University of Cincinnati run by Dr. John Botsford, Director of Radiology, Deaconess Hospital, and Dr. Choy. In one of the sessions, one of our students

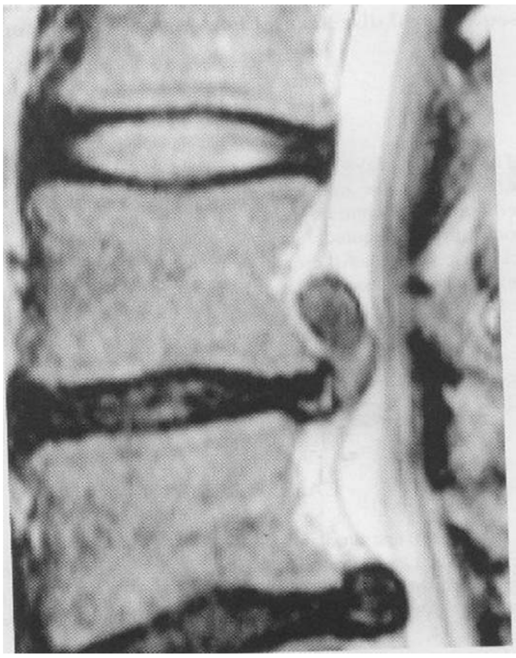

Fig. 13. Disc herniation with cephalad extrusion.

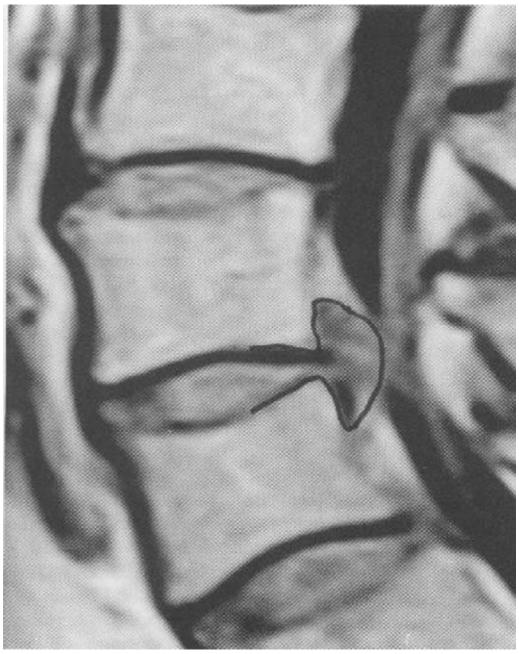

Fig. 14. Disc herniation with a mushroom extrusion.

reported performing successful PLDD on an *extruded* disc that was still anatomically connected to the parent disc. Our group therefore began treating such discs with success. Complex disc extrusions can be treated if there remains an anatomic connection to the ''parent'' disc (Figs. 13 and 14).

Other possible indications are as follows.

- *Spinal stenosis:* In 1997, Dr. Jeffrey Ngeow (NY Hospital for Special Surgery) started investigations to see if PLDD would work in spinal stenosis primarily caused by incursion into the spinal canal by a protruding disc. He found a clinical response similar to disc herniation without spinal stenosis [17].
- *Correction of erectile dysfunction:* This was an unexpected result in one of Choy's patients [18], and since then several similar reports have occurred [18].
- *Correction of cauda equina syndrome:* A patient appeared in Choy's office 3 years after successful PLDD to the L4-L5 and L5-S1 discs, with sudden onset of a classical cauda equina syndrome. He refused immediate open surgery and insisted on a trial of immediate PLDD. After informed patient consent, PLDD was reapplied to L4-L5 and L5-S1 discs. His cauda equina syndrome disappeared in the first 24 h, and has not returned in 5 years [19].
- *Extrathecal and transthecal entry into the L5-S1 disc:* A high iliac crest or other anatomic variation may prevent the standard dorsolateral entry that ends with the proper parallel positioning of the needle in the L5-S1 disc. If the needle is angled and points at an endplate, the laser can cause thermal damage to the endplate. In 2003, we tried an extrathecal approach that resulted in proper positioning of the intradiscal needle. It was soon found that even this approach was not possible, and a direct transthecal approach was tried. To date, these two approaches have been used 158 times with success with no neurologic sequelae [20]. We speculate that the conical ''pencil-tipped'' trocar may have successfully ''pushed'' the fibers apart.
- *Cervical disc herniations:* Fluoroscopic imaging [21] is sometimes difficult to impossible in patients with short, thick necks. By turning the X-ray unit 30–35° from the horizontal, the shoulders are removed from view and it is often possible to image the lower discs. An occasional C7-T1 disc can be imaged. Before attempting PLDD of the cervical spine, it is advisable for the laser surgeon to undertake special training because of the special anatomical hazards of this portion of the spine.

Last but not least, some ''experiments in nature'' seem to confirm that PLDD works through change in intradiscal pressure. A stunt pilot patient reported sciatic pain aggravation on pulling out of a plus 6 g dive, and almost immediate relief performing a minus 3 g outside loop [22]. A surgeon-patient SCUBA diver reported sciatic pain relief if he performed 10 daily 100 foot dives (10 min each), and gradual return of all pain on return from vacation [23].

Separate branch of PLDD

Since the original PLDD procedure was started with the simple introduction of the Nd:YAG laser via a needle inserted into the target disc, with local anesthesia and under biplane fluoroscopic control, a separate branch of the technique has added endoscopic viewing and a Ho:YAG laser. This approach has gained a following among a group of laser surgeons, among them Dr. Martin Knight, Dr. Anthony Yeung, Dr. David Caspar, Dr. Werner Siebert, and Dr. Sang-Ho Lee's group in South Korea.

One of the leaders of this group is Dr. Sang-Ho Lee, neurosurgeon-in-chief of the Wooridul Spine Hospital in Seoul, Korea, a well-known and respected laser spine surgeon. To make this report complete we have chosen to include his data (1992–1999), and he is listed as a co-author representing this PLDD/endoscope faction. Dr. Lee's clinical data are listed in the Table 1.

Comparing the PLDD procedure using the Nd:YAG laser and the Ho:YAG laser with each other, Choy refers to the following points.

Because the transfer of energy to water is much greater in the Ho:YAG laser than in the 1060 nm Nd:YAG laser, in the former, continuous saline irrigation is necessary to cool the fiber and needle tip. Thus, an additional channel must be provided in the ''needle'', therefore enlarging the minimum o.d. of the needle to 2.5 mm. The o.d. of the 18 G needle used in the Nd:YAG laser is 1.0 mm. Addition of viewing optics further enlarges the needle o.d. of the Ho:YAG laser to 6.5 mm. The use of the Ho:YAG system is therefore more invasive than the simpler Nd:YAG system.

Moreover, Dr. John Botsford and Dr. Choy have observed ''burn-back'' of fiber tips that were then left behind as foreign bodies (Fig. 15) in the Ho:YAG system, and thermal damage to adjacent endplates (Fig. 16) by inexperienced laser surgeons following the manufacturer's printed instructions advocating radial irradiation through 360° with the side-firing fibers.

As the expert witness in a number of malpractice actions through the years involving thermal damage to nerve roots and thermal induction of cauda equina syndromes, Dr. Choy has encountered only the side-firing fiber used with the Ho:YAG laser.

And finally, it is a tribute to the consummate skill of some of the laser surgeons using the Ho:YAG-optical

Table 1. Worldwide PLDD results.

Physician	Dates	No. of patients			No. of discs				Results	
		M	F	Total	Lumbar	Thoracic	Cervical	Total	McNab	Complications
Hellinger Germany	1989–2009	–	–	4644	9835	61	850	10,746	85% Good	–
Choy USA	1986–2009	–	–	3157	5704	16	480	7200	89% Good	0.3% discitis
Tassi Italy	2003–2009	1132	1055	2187	2212	0	162	2374	83.8% Good	0.1%
Gozlan France	2004–2007	30	27	57	–	–	60	60	87% Good	2% discitis
McMillan [34] USA	2004	–	–	32	32	–	–	32	75% Good	–
Sobieraj [35] Poland	2003–2004	–	–	212	212	–	–	212	79% Good	–
Gupta [36] India	2006	–	–	40	45	–	–	45	92% Good	–
Vasilyev [37] Russia	2008	–	–	120	120	–	–	120	84% Good	–
Machner [38] Germany	1992–1995	–	–	289	289	–	–	289	70.4% Good	3% discitis
Harada [39] Japan	2001	–	–	7	–	–	7	7	100% Good	–
Kosaka [40] Japan	2001	–	–	13	–	–	13	13	46%	4 needed open surgery
Menchetti [41][a] Italy	2008	585	315	900	627	8	–	635	85% Good	0.8% (spondylitis)
Grönemeyer [42] Germany	1991–1997	–	–	200	200	–	–	200	84.5% Good	0.5% (discitis)
Gevargez [43][a] Germany	1998–1999	–	–	26	26	–	–	26	85% Good	–
Dupuy[a] France	2006	–	–	30	30	–	–	30	76.6%	–

Table 1. (*continued*)

Physician	Dates	No. of patients			No. of discs				Results	
		M	F	Total	Lumbar	Thoracic	Cervical	Total	McNab	Complications
Lee[b] South Korea	1992–1999	377	248	625	548	9	69	626	84.1–87.5% Good	7.2% residual pain 5.8% transient numbness

Notes: In addition to the numbered references, data included in this table was also obtained from unpublished PLDD status reports from Drs. Johannes Hellinger (Germany), Daniel S. Choy (USA), Gian Paolo Tassi (Italy), Eric Gozlan (France), R. Dupuy (France), and Sang-Ho Lee (South Korea).
Where diode and Ho:YAG lasers with endoscope were used, they are so listed (see notes above). Where no lasers are listed, the Nd:YAG laser was used, with the 1 mm diameter needle.
[a]Physician uses diode laser.
[b]Physician uses Ho:YAG laser with endoscope.

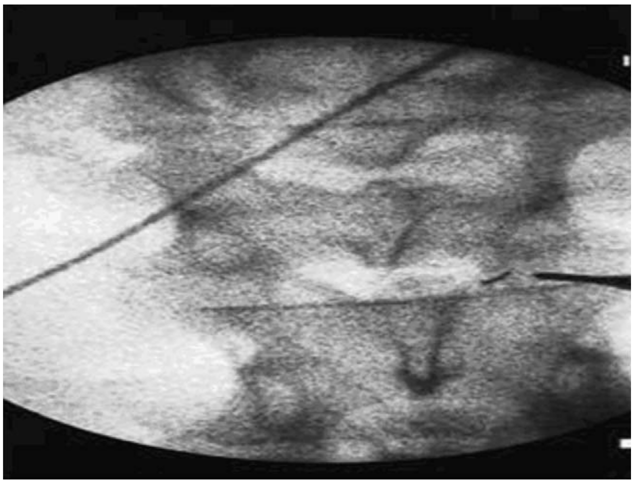

Fig. 15. Burnt needle/fiber tip left behind in a Ho:YAG-treated patient.

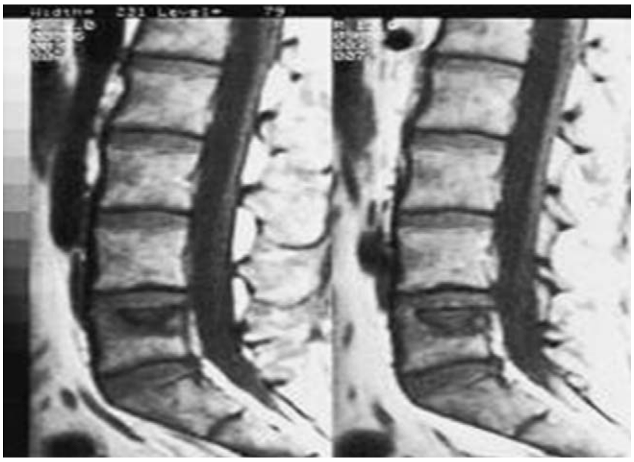

Fig. 16. Necrosis of the cranial portion of the L5 vertebra has been caused by the side-firing fiber system of the potassium triphosphide (KTP) laser. This effect can also be seen with the Ho:YAG laser, but never with the direct-firing Nd:YAG laser.

system that they have been able to achieve, clinical results approaching the 65–89% success rates of the much simpler Nd:YAG system (see Table 1) in spite of the multiple handicaps.

Radiologic guidance for needle placement

The method of needle placement with biplane fluoroscopy is clearly described under "Scientific rationale" and in Figs. 7 and 8. It is simple and effective. Choy has performed this accurately more than 7000 times in 23 years.

But nowadays, there are new trends in clinical research. Sequeiros et al. [24] reported on the use of MRI guidance to place a guidance needle to ablate osteoid osteomas. Von Jako and Cselik [25] described the use of a stereotactic computer-assisted surgical navigation in treating 12 lumbar discs in two fresh porcine specimens. Whereas Streitparth et al. [26] reported on an MRI-guided needle placement in the laser ablation of an osteoid osteoma in a single patient.

In principle, when there are multiple methods available for needle insertion guidance, it makes optimum sense to pick the least expensive and simplest method that is effective, in this case, biplane fluoroscopy.

Needle placement with MRI control is a cumbersome procedure, and ineffective. But it should be not neglected that with the help of an open MR system the physician is able to look at both planes in real time (delay less than 1 s) and can place the needle "live". Moreover, MR technology provides reliable information about temperature rise around the fiber tip during the laser action (delay about 10 s). In case of the described treatment of an osteoid osteoma [26], which was located only millimeters away from the cartilage of the joint, it was of utmost importance to monitor the temperature during laser ablation.

Results

Representative results from 16 laser centers in USA, Germany, Italy and South Korea and others are shown in Table 1. Pain relief occurs usually at the end of the procedure. According to the MacNab criteria (Table 2) overall success rates range from 65 to 89%. Recurrence rates are 5%, and usually result from lifting objects heavier than 7 kg. Major complications average 1% and are usually due to infectious discitis that respond to parenteral vancomycin administered for 6 weeks. The return of absent reflexes to normal reflexes, are seen immediately in 50% of cases treated. Most patients return to work in 7–10 days.

PLDD has been performed worldwide for 23 years and has demonstrated the safety, efficacy and minimally invasive character of the technique for outpatient treatment of herniated disease of the cervical, thoracic, and lumbar spine. Complications can be minimized by performing PLDD in an outpatient setting thereby avoiding the special bacteriological hazards of hospitals. The reproducible excellent results in the hands of laser surgeons worldwide have established PLDD as a first-line therapy for herniated disc disease.

Table 2. MacNab criteria.

Response	Criteria
Good	Resumes preoperative function Occasional backache or leg pain No dependency-inducing medications Activity appropriate No objective signs of nerve root involvement
Fair	May be nonproductive if unchanged from preoperative status Intermittent episodes of mild lumbar and/or low back pain No dependency-inducing medications Activity appropriate No objective signs of nerve root involvement
Poor	Subjective • No productivity • Continued pain behavior • Medication abuse • Inactive Compensation and/or litigation focus Objective signs of continuing radiculopathy

The future

Choy [27] noted a 43% incidence of disc herniation in first-order relatives of 2000 patients with herniated disc disease (HNP) compared with a national incidence in the United States of 1.7%. He postulated a collagen defect with weakness of the posterior longitudinal ligament, and perhaps of the annulus in HNP, leading to decreased resistance to posterior herniation with increase of intradiscal pressure. Clinically, multiple disc herniations in single patients are common. The epidemiologic evidence of a congenital etiology for HNP is further supported by Annunen [28], who found heterozygous substitution of tryptophan for glycine or arginine in the collagen IX chain. In mice, mutations of collagen IX cause disc degeneration and herniation. Five percent of the Finnish population has HNP and many have the tryptophan substitution. Laminectomy and discectomy, by incising the posterior longitudinal ligament (PLL) and annulus, may further weaken an already weakened posterior wall, thus leading to the 21%, 15%, 37%, 3–19%, and 18% re-herniation rates after open surgery reported by Delamarter and Bohlman [29], Malter et al. [30], Matsunaga et al. [31], Grane [32], and Weir and Jacobs [33], respectively.

The 1.0 mm-needle puncture by an 18 G needle used in the Nd:YAG-PLDD system does not weaken the posterior wall.

The re-herniation rate in Choy's series of 7200 procedures is 5% and is usually due to lifting heavy objects.

Conventional laminectomy and discectomy has been used for 75 years since it began at the Massachusetts General Hospital in 1934. Within that space of time, other scientific advances have taken place include space exploration, organ transplantation, and percutaneous coronary bypass surgery. Open surgery, and even microdiscectomy have remained essentially unchanged. PLDD, on the other hand, offers a minimally invasive outpatient procedure for the treatment of herniated intervertebral discs with outcome statistics superior to those of traditional open surgery.

Overwhelming clinical information should lead to re-evaluation of conventional and traditional methods of treatment. We believe that PLDD is the way of the present, and of the future.

Summary

To summarize the data in Table 1, 12,539 patients have been reported by 16 authors from the USA, Germany, Italy, France, Russia, Poland, Japan, India, and South Korea.

There were 1641 cervical, 94 thoracic, and 19,880 lumbar discs treated with no serious complications. They were chiefly discitis. The success rate according to the MacNab criteria averaged between 70% and 89%. Most authors reported immediate pain relief. Choy is aware of PLDD being performed in China, Spain, and Colombia. Since its introduction, it is estimated that more than 100,000 PLDD procedures have been performed worldwide.

Zusammenfassung

23 Jahre Perkutane Laser-Diskusdekompression (PLDD) – Stand der Technik und Zukunftsaussichten

Im Februar 1986 führten Peter Ascher und Daniel S.J. Choy die erste Perkutane Laser-Diskusdekompression (PLDD) in der Neurologischen Abteilung der Universität Graz in Österreich durch. Es war geplant einen Patienten, der aufgrund eines lumbalen Bandscheibenvorfalls im Bereich L4/5 an einem Ischiassyndrom litt, mit einem Nd:YAG-Laser bei einer Dosis von 1000 J zu behandeln. Bereits nach einer Applikation von 600 J trat Schmerzfreiheit ein und die Behandlung konnte vorzeitig beendet werden.

Seitdem hat sich die PLDD weltweit als Behandlungsmethode des Bandscheibenvorfalls verbreitet. Ausgenommen im Bereich der oberen Brustwirbelsäule (T1-T4) kann die Prozedur mittels perkutaner Punktion minimal invasiv erfolgen. Die Erfolgsrate der Methode liegt zwischen 70–89%, die Komplikationsrate (hauptsächlich entzündliche Begleiterscheinungen) bei 0.3–1.0%. Verläuft die Behandlung erfolgreich, kann die Arbeitsfähigkeit durchschnittlich bereits nach einer Woche wiederhergestellt werden. Eine Auswertung der Ergebnisse der letzten 23 Jahre ergab eine Rückfallrate von 5%.

Schlüsselwörter: Laser; Bandscheibe; Dekompression; Perkutan; Hernie; Ischiassyndrom

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