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Rearview of medical laser application in neuro-tumor operations

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Abstract
The effectiveness of endoscopic therapy to the NEURO Co2 laser path utilizing the Nd:YAG laser file was the subject of a medical study done as part of the medical diagnostic study for physicians receiving training in curative surgery and neurology. Discovering the ELANA system's initial application. whereby eight patients with ischemia and 26 patients with big aneurysms were examined. As a result, diagnostic findings from frozen biopsies and frozen section biopsies seemed to be comparable. In neurosurgery, exogenous fluorescent dyes have been utilized in conjunction with LSCE to enhance morphological features. The ability to proliferate is stronger in SR101 astrocytoma cells.

Keywords: Nd: YAG, SR, c_{O_2}, tumor, surgery

Introduction
The neurosurgeons at Boulder Neurosurgical & Spine Associates make use of this. A brand-new laser technology was created at the Massachusetts Institute of Technology (MIT) to be used as an additional tool during disc and fusion surgery. With this technique, scar and disc tissue are evaporated without causing harm to the surrounding tissues thanks to a flexible carbon dioxide laser energy delivery system. The neurosurgeons of Boulder Neurosurgical & Spine Associates are on the right.
You will notice a big difference when doing spine procedures using laser assistance.
In contrast to standard tool surgeries. We may now easily extract (dissolve) the arthritic tissue rather than straining and pulling it.

Fig 1: Beam Path NEURO Co2 Laser

Since the 1970s, lasers have been utilized in neurosurgery to treat brain malignancies. However, because of its lack of flexibility and consequent inability to deploy lasers only in the direct line of sight of the surgeon, its use in spine surgery has been restricted.

The first multipurpose laser energy delivery device in the world is the Beam Path NEURO CO_2 laser. In addition to treating brain and spinal malignancies and arteriovenous malformations, when performing discectomy or fusion procedures, this laser can be used as an extra tool to help remove the disc more easily. Because it allows for the ablation of tissue in the lateral recess, including osteophytes and durable connective tissues, we think that this new CO_2 laser-assisted technique has the potential to increase operating room efficiency. This method is potentially less likely to harm the neighboring nerve root than previous laser-assisted discectomy methods due to the tiny lateral thermal spread. The nociceptive fibers within the annulus wall can also be cauterized with the CO_2 laser. We anticipate better clinical outcomes and a more thorough resection of the ruptured disc as a result. Medical study on lasers began in 1960, the same year that lasers were first utilized in medicine. This state-of-the-art technology has a wide range of therapeutic possibilities, even based on early study. Low-power lasers have been employed for a wide range of medical ailments since those initial experiments.

Because it is problematic, there is ongoing discussion about this therapeutic technique.

Because there are so many variables (such as frequency, energy, treatment timing, and location) that can be chosen, there is uncertainty regarding the mode of action used in therapy and a lack of agreed-upon protocols for certain applications. Researchers have been examining the impact of laser-induced hyperthermia on tumor tissues, since the 1980s, utilizing experimental models, encompassing the meninges and brain tissue. The wavelength and power of the light used in the laser, the tissue's absorption characteristics, and the many biological responses to the laser's energy all affect how a laser affects tissue [9]. In when low-energy laser light is applied to tissues, increasing the laser's energy intensity can have a variety of effects, from the most destructive at the point of contact to the most stimulating at the farthest out.

Diverse types of lasers have diverse applications because different wavelengths cause the tissue to penetrate at varying depths before the surface layers vaporize.

Table 1: Approximate interaction of laser light with living tissue*

Energy density (J/cm^2)	Biological effect
<4	Biostimulation
>4	Biosuppression
40	Non-thermal cytotoxic phototherapy with sensitizing agents
400	Photocoagulation and thermal effects
4, 000	Vaporization and thermal affects

*Table used with permission from Brown SG: Phototherapy of tumors, World J surg 1983;7:700-9

Laser in open surgery

Since the laser was initially applied to treat malignant gliomas in humans in 1966, its potential as a neurosurgical tool has been thoroughly studied. Takizawa found that supplementing standard neurosurgery instruments with carbon dioxide lasers reduces the amount of manipulation and invasion of normal brain tissue, based on one of the largest and oldest case studies. But since then, interest in using lasers in open neurosurgery has decreased because of technological concerns and constraints. It is important to employ a CO_2 laser the vast wavelength of optical fiber has a limit. The ability to provide enough electricity to the surgical area. Eighty Through binoculars, they scan the area. Laser garnet containing argon or neodymium-yttrium (Nd: YAG) may also contain neodymium. It was demonstrated that the ablation site caused damage to healthy brain tissue. Despite these drawbacks, recent technological developments in the sector, and ongoing research-particularly with CO lasers that employ unique power transfer techniques-I heartily suggest it.

Endoscopic neurosurgery with laser assistance

Laser treatment for arachnoid cysts has proven to be successful. Choi *et al*. carried out the largest prospective investigation of the efficacy of laser-assisted endoscopic treatment. They achieved a 79 percent success rate (30 W) in cutting and coagulating the cyst wall using a Nd: YAG laser. In a case report published by Van Beijnum *et al*., laser-assisted endoscopic fenestration was used to successfully fenestrate a suprasellar arachnoid cyst. There isn't much data to support the effectiveness and safety of endoscopic laser therapy overall. Regarding surgical results, however, no trials have contrasted microsurgical cyst excision, stereotactic aspiration, or cyst peritoneal shunting with laser-assisted endoscopic cyst fenestration. Calisto detailed the procedure he utilized to make a surgical incision for the contralateral endoscopic excision of a hypothalamic hamartoma from the wall of the third ventricle using a 15-W thulium: YAG surgical laser. He claimed that the laser helped him make an accurate incision in the deep brain.

An aided laser micro anastomosis

Excimer laser-assisted non occlusive anastomosis (ELANA; Elana, Inc., Columbia, Maryland, USA) is a cerebral revascularization procedure that produces a high-flow bypass. Compared to standard procedures, the ELANA system has no risk of stroke due to transitory vascular blockage. It also has fewer distal-end graft complications because of the stability that the metal-ring implantation provides during the process sequence. Furthermore, the process is not prolonged by the approach. The following actions are performed in ELANA:

1. Without obstructing the flow, a metal ring with a minimum diameter of 3 mm is sutured to the end of the graft vessel and subsequently to the recipient's vessel.
2. An ELANA catheter with optic fibers inserted circumferentially into the saphenous vein graft, together with two 5-second laser events, creates a circular arteriotomy in the recipient artery wall (10 MJ, 40 Hz). A built-in suction vacuum at the catheter tip pulls the severed vessel wall back. Reference 134 An excimer laser with XeCl wavelengths produces coherent light (CVX-300; Spectranetics Corp., Colorado Springs, Colorado, USA).

This intravascular circular laser technology is becoming more and more common in cardiovascular surgery for the removal of cardiac stimulator leads and atheroma’s in patients with in-stent restenosis.

One of the earliest clinical research investigations to assess intraoperative flow with the ELANA system was conducted by Van der Swan *et al*. There were 26 individuals with large aneurysms and 8 patients with ischemia in the research. In light of the results, the authors proposed classifying the ELANA device as a "high-flow" external-internal carotid bypass.

Seven patients with significant cerebral aneurysms who had the ELANA bypass treatment had good flow and great results, according to another study.

Following that, the suture-free ELANA technique-also referred to as SELENA-was created and is presently undergoing testing. Its primary benefit over ELANA is that it attaches to the recipient's vessel with two pins after a unique metal ring is placed on the end of the graft vessel. The anastomosis is sealed with a circumferential layer of BioGlue surgical glue (CryoLife, Inc., Kennesaw, Georgia, USA) prior to utilizing the ELANA technique's laser to produce an arteriotomy. Using a Trinity Clip anastomotic connector, another technique for laser-assisted anastomosis provides an elliptical 0.8 2.0-mm end-to-side suture-less anastomosis that could be utilized in the future for cerebral bypass surgery.

It seems that the ELANA system is a secure and useful tool for intracranial bypass surgery. Cerebral high-flow bypasses are still a rare surgery done in a small number of patients, and most anastomoses are still sutured by hand, even with the potential benefits of nonexclusive anastomoses. It is not only the length of artery blockage time or issues with micro suturing that might lead to neurological consequences; high-flow bypasses are usually employed in severe instances with poor prognoses. This clarifies the reason behind the decreased use of ELANA in intracranial bypass surgery. NBS, or NeuroBlate System People can communicate with one another using the NeuroBlate technology (Plymo, Monterey Medical Corp).

Diagnostic applications for lasers in neurosurgery

Laser-assisted end microscopy in neurosurgery Laser-scanning confocal microscopy (LSCM) is becoming a common tool in basic science research.

Research indicates that it is safe to use intraoperatively in neurosurgery. The acronym for large-scale computational modeling is Large Scale Computational Modeling (LSCM). The specimen is irradiated in the near-surface and deep waters point-by-point. Unlike most others, the surface of this microscope is flat. You can therefore carry it out in this way anytime you'd like.

The specimen is only partially illuminated; the remaining area is lit up by extra lights coming from different directions. A pinhole is used to reject more portions of the specimen. Images with greater information in the lab, LSCM produces high-resolution, depth-selective pictures that enable real-time 3D cellular and subcellular observation. The drawback of this imaging technique is that it necessitates a prolonged period of lighting at the area.

This technique has been employed in the past, but zirconium arc lamps or lasers are typically utilized with a higher light intensity or for a longer duration. Endoscopes had laser-scanning confocal microscopy (LSCM) installed. One kind of medical imaging technology with a wide range of uses is end microscopy (LSCE). LSCE provides a clearer image of the borders of brain neoplasms.

Sankar *et al*. and Martirosyan *et al*. employed a range of fluorophores in their research, including handheld LSCE, and showed that *in vivo* brain extraction might benefit from histology data on normal and malignant cells as well as fluorescein sodium, 5-ALA, and neocyanine green. Initially, the treatment of several brain cancers showed encouraging outcomes when sodium was used as a contrast medium intraoperatively along with fluorescein and LSCM. Diagnostic results were similar between frozen section biopsies and frozen section biopsies. Exogenous fluorescent dyes are now available for use with LSCE in neurosurgery, allowing for improved morphological details. SR101-labeled astrocytoma cells have a higher proliferative capacity, according to Georges *et al*, who used self rhodamine and confocal microscopy. Morphological characteristics that set them apart from astrocytes, suggesting that this technique may be applied to a better see tumor margins with a microscope. There are several applications for an additional laser. The group is currently employing fluorescence imaging technologies with a scanning fiber endoscope. Examined. Surgery patients can still get useful information from it even though histology-like imaging resolution is not present.

The large tissue sections visible with this approach could be beneficial to the study. Neurosurgery may benefit from ongoing developments in laser imaging technology. Improved *in vivo* imaging could help surgeons identify and treat patients more successfully. Eliminating abnormal tissue.

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