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HOLMIUM LASER AND ITS APPLICATIONS IN OTOLARYNGOLOGY

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Introduction

INTRODUCTION

In this study we are going to present the holmium 2100 nm wavelength laser technology, with special stress on the physical principles of laser, its advantages compared to other types of laser, and its different clinical applications in otolaryngology.

Review of the available literature revealed that the first application of holmium laser was in 1987 (*Goldman et al., 1987*). This new laser fulfills many of the ideal criteria of laser surgery. The ideal criteria of laser surgery should fulfill the following criteria (*Shapshay et al., 1991*).

1. Good haemostasis: The laser should provide capillary and small venule (up to 1 m.m diameter) haemostasis.
2. Precise control of tissue ablation: The laser should have good control of the depth of vaporization for cutting ablation, and coagulation of tissue.
3. Bone removal: The laser should have the ability to remove bone layer by layer without overheating or cooking.
4. A fiberoptic delivery system: This system should be compatible with telescopic optics.

Holmium laser has been used in the following:

- In otolaryngology:
 - Endoscopic sinus surgery (*Shapshay et al., 1991*).
 - Laryngotracheoplasty (*April et al., 1991*).
 - Stapedectomy (*Kauizky et al. 1991*).
 - Turbinate and tonsil surgery (*Oswal and Bingham, 1992*).

- In ophthalmic surgery:
 - Glucoma surgery (*Hill et al., 1991*).
- In Cardiovascular surgery:
 - Angioplasty in humans (*Heuser and Mehia 1991*).
 - Atherectomy (*Aretz et al., 1991*).
 - Experimental ablation of cardiac valves (*Lilge et al., 1989*).
 - Sutureless microvascular anastomosis (*Bass et al., 1989*).
- In General surgery:
 - Biliary system surgery (*Oz et al., 1989*).
- In Orthopedic surgery:
 - Ablation of articular cartilage and miniscal fibrocartilage (*Trauner et al., 1990*).
- In Gynecological surgery:
 - Endometrial laser ablation as an alternative to hysterectomy (*Rosenberg et al., 1990*).
- In Dental surgery
 - Temporomandibular joint arthroscopy (*Silkiss et al., 1992*)

The Development of Laser

McBurney in 1990 stated that the first continuous wave laser was the helium neon laser. It produced low power red laser, and it is still in use as an aiming beam and in alignment. Its power is too low for therapeutic use, although its role in biostimulation was being investigated.

In 1965, the continuous wave carbon dioxide laser was introduced. Since that time, the carbon dioxide laser became the laser most commonly used. It had a unique value in gynecology and otolaryngology. Early animal experiments with laboratory machines were carried out, it was essential to use moving tables to move the anaesthetized animals beneath the fixed, focused laser beams. These experiments demonstrated the potential of this laser as a surgical tool (*Carruth, 1987*).

In 1969, the first carbon dioxide laser system was developed by the American optical corporation. At the same time the argon laser was also investigated. The latter is a continuous wave device which is now widely used for retinal photocoagulation (*Zweng, 1971*).

In the mid.1960s, the pulsed neodymium glass laser was investigated and have been rejected by many surgeons (*Carruth, 1987*).

In the early 1970s, the continuous wave neodymium YAG [Yttrium Aluminium Garnet] laser was developed, which produced near infrared coherent light. This was used for thermal tissue destruction and blood vessel coagulation. The pulsed Nd-YAG was recently been introduced. It produces precisely localized lesions in which the temperature was higher than that of the sun, and shock waves from those were used to destroy opaque structures within the

eye. Pulsed laser were also used for the destruction of renal stones by its photomechanical effect (*Carruth, 1987*).

The dye laser has been investigated for the use in two main areas, First treatment of tumours by photodynamic therapy (*Castro, et al., 1991*), second selective destruction of blood vessels within the skin in the treatment of port wine stains and other cutaneous malformations (*Crockett and Reynolds, 1990*).

In the mid 1980s, the excimer laser was developed which had enormous potential for producing remarkably precise incision (*McBurney, 1990*).

Review of available literature revealed that the first application of holmium laser was in 1987 (*Goldman et al, 1987*). This new laser met many of the ideal criteria of laser surgery (*Shapshay et al, 1991*).

The holmium laser theoretically should ablate tissue in a manner similar to the carbon dioxide laser with the advantage of being efficiently transmitted through flexible quartz fibers. (*Oz et al, 1989*).

Laser Physics