LASERS IN DENTISTRY

Proceedings of the International Congress of Laser in Dentistry, Tokyo, Japan, 5–6 August 1988

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PREFACE

After the oscillation of the ruby laser beam by T.H. Maiman in 1960, it took only a quarter of a century before lasers became the multidisciplinary and multispecial tool in clinical medicine. At present, lasers are extensively applied in ophthalmology, surgery, and other clinical departments of medicine. Lasers are also utilized widely for various kinds of medical examinations, diagnosis, information processing and rehabilitation, and their application areas are expanding rapidly. In the field of dentistry, the use of the laser as a replacement for the dental drill was the first idea, however, the first successful application of laser in dentistry was the prevention of dental caries by means of laser irradiation. After the fruitful success of the 4th Congress of the International Society for Laser Surgery, LASER TOKYO '81, clinical application of lasers in dentistry has been promoted more and more in Japan. The Japan Society for Laser Medicine decided to organize the international congress focused on lasers in dentistry. This Congress was the first attempt to bring world-wide specialists together to discuss and improve this new frontier of 'Laser Dentistry'. The Congress was co-sponsored by the Japanese Association for Dental Science, Japan Dental Association and Tokyo Dental Association.

The International Congress of Laser in Dentistry was held in Tokyo, Japan on August 5th and 6th, 1988, hosted by Professor Hajime Yamamoto. There were 400 participants, including 60 from 16 foreign countries. The main theme of the Congress was 'Application of laser to oral and maxillofacial region'. The scientific program consisted of 4 special lectures, 1 symposium, 3 workshops and 44 free papers. The special lectures were as follows; 'Past, present and future in laser medicine and surgery' by Dr. K. Atsumi (Japan), honorable president of the Congress and president of the Japan Society for Laser Medicine; 'More than 10 years CO_2 laser research and applications in dentistry: computerized analysis' by Dr. F. Meicer (France); 'Essentials of laser' by Dr. H. Inaba (Japan); 'Studies of low power laser therapy of pain' by Dr. K. Kamikawa (Japan). The 6 symposiasts presented the clinical experiences of laser therapy in many fields of dentistry under the theme of applications of lasers in dentistry.

Free papers were divided into 8 topics; Basic research (8 papers), Instrumentation (6 papers), Measurement and diagnosis (5 papers), Oral and maxillofacial surgery (11 papers), Dental caries and dental pulp (5 papers), Periodontology (3 papers), Analgesic effect (3 papers) and Treatment of malignant tumor (3 papers).

The symposium and free papers, disclosed clearly that lasers had many advantages in therapeutic and preventive dentistry in all fields of dentistry such as surgery, caries prevention and pain clinic; and also pointed out the necessity of basic research, especially about the biological effects of low power lasers.

This volume will include the most important papers of those presented in the Congress, and provide clinicians and researchers with the opportunity to learn much about the extensive, up-to-date information on several new therapeutic and diagnostic strategies in laser dentistry. The Congress and this book should be a stepping stone to the future development of laser dentistry and it is not too much to say that 'laser dentistry' is future dental science. We believe that laser dentistry will

enable us to pave the way for the diagnosis and treatment which could not be achieved by conventional methods.

During the Congress, delegates from the participating countries discussed the future of laser dentistry and decided to organize the congress periodically. The 2nd International Congress of Laser in Dentistry will be held in Paris in 1990. The Chairman will be Dr. J. Melcer, Professor of University Paris-V, and the tentative Secretary General, Professor H. Yamamoto. There was also a discussion about the inauguration of the International Association of Laser Dentistry. It is expected that many participants from all over the world will attend the 2nd Congress and contribute to the establishment of the International Association of Laser Dentistry.

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Lasers in dentistry
H. Yamamoto, K. Atsumi and H. Kusakari, editors

CURRENT STATUS AND FUTURE OF LASER SURGERY AND MEDICINE IN JAPAN

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INTRODUCTION

Japanese research on laser surgery and medicine was started in 1965 to study irradiation effect on tissues and tumors of mice by ruby laser by author in University of Tokyo.

In 1966, high power ruby laser unit for medical use was constructed and applied for the first clinical case of skin cancer in University of Tokyo in 1967.

In 1968, high power CO_2 laser unit was constructed and basic studies were done. In 1969, CO_2 laser was used in neurosurgery by Dr. Takizawa.

In 1973, CO_2 laser was applied in ENT by Dr. Mihashi. Argon and ruby lasers were used in plastic surgery by Dr. Ohmori.

In 1974, the Q-switch of Nd-YAG laser was applied for dental caries prevention by Dr. Yamamoto.

In 1975, CO_2 laser unit was used in oral surgery by Dr. Nagasawa.

In 1977, the first Japanese Meeting of Laser Medicine was organized and 50 medical doctors and engineers joined in this meeting.

In 1979, the first YAG laser endoscopy treatment for gastrointestinal bleeding was performed by Dr. Mito.

In 1980, laser acupuncture was done by Dr. Ohnishi.

In 1980, the Japanese Society of Laser Surgery and Medicine was organized and the first conference was carried out. 300 medical doctors and engineers joined in this conference.

In 1981, photodynamic therapy for lung cancer was started by Dr. Hayata.

In 1985, a new laser hospital was constructed at Omiya 20 miles north of Tokyo. In this hospital, YAG, argon and argon dye laser units are centralized and the laser powers are transmitted to the operations rooms and outpatients rooms through the optical fiber. Laser selection, power, safety, appointment are controlled by computer.

In 1987, the number of members of Japanese Society for Laser Surgery and Midicine counted over 1,000. The major parts of the specialities are surgery, endoscopy, oral and dental, ENT and plastic surgery. (Table(1))

TABLE 1

HISTORY OF LASER SURGERY IN JAPAN

1965 Ruby Laser (2-7 Joules) Radiation Effects on Tissues and Tumors of Mice (K.Atsumi, et al.)

1966 High Power Ruby Laser Unit (50 Joules) for Medical Use (K. Atsumi, et al.)

1967 The 1st Clinical Case - skin cancer - (Ruby) Laser Treatment (K.Hishimoto, K.Atsumi, et al.)

1967 Ruby Laser (4 Joules) Radiation Effects on Teeth (H. Yamamoto, et al.)

1968 High Power CO_2 Laser (50 Watts) Unit and it's Biological Effects (K. Atsumi, et al.)

1968 He-Ne Laser (10 mW) Radiation Effects on Brain Tissues and Tumors of Mice (K.Kamikawa, et al.)

1969 CO_2 Laser (35 W) in Neurosurgery (T. Takizawa)

1970 Argon Laser (1 W) Radiation Effects on Brain Tissues and Tumors of Mice (K. Kamikawa, et al.)

1973 CO_2 Laser (38 W) in Otolaryngology (S. Mihashi, et al.)

1974 Nd-YAG Laser (50 W) in Neurosurgery (K. Kamikawa, et al.)

1974 Nd-YAG (Q-switch) Laser for Dental Caries Prevention (H. Yamamoto)

1975 Argon Laser in Plastic Surgery (S. Ohmori)

1975 CO_2 Laser (50 W) in Oral Surgery (A. Nagasawa)

1975 Ruby Laser (160 Joules) in Plastic Surgery (T. Ohshiro)

1977 CO_2 Laser (50 W) in Plastic Surgery (Narong Nimsakul)

1977 The 1st Japanese Meeting of Laser Medicine (November, Tokyo)

1978 CO_2 Laser (100 W) Surgical Unit for Medical Use (K. Atsumi, et al.)

1979 Nd-YAG Laser Endoscopy Treatment for Gastrointestinal Bleeding (M. Mito, et al.)

1980 Laser Acupuncture (Ohnishi)

1980 Nd-YAG Laser Endoscopy Treatment for Stomach Cancer (K. Mizushima)

1980 The 1st Conference on Japanese Society of Laser Surgery and Medicine (November, Tokyo, Presided by Dr. M. Osada)

1981 Laser Photoradiation Therapy for Lung Cancer (Y. Hayata)

1981 Laser Spectro Analysis for Cancer Diagnosis (T. Sakita)

1982 CO Laser Surgical Unit (M. Kikuchi)

1982 Laser Pain Therapy (K. Kamikawa)

1982 Laser Micro-Vascular Anastomosis (N. Hayashi)

1983 HpD-Laser Photoradiation Therapy by N_2-Dye Laser (K. Ida)

1983 Laser Pain Therapy -Diode Laser- (T. Oshiro)

1984 Photodynamic Therapy by Gold Vapor Laser (H. Kuzumi)

1984 Medical Application of Excimer Laser (K. Aizawa)

1984 Laser Cholelithotripsy through Bile Duct (T. Kozu)

TABLE 1

HISTORY OF LASER SURGERY IN JAPAN (continued)

1985 : PDT by Use of Pheophoride Irradiated by Nd-YAG Laser (S. Mashiko, H. Inaba)

: Laser Reactive New Metal Complex (Platinum Blue Fluorescein Sodium Complex) for Brain Tumor Therapy (N. Hayashi)

: Percutaneous Trans-hepatic Laser Vaporarization (D. Hashimoto)

: Nd-YAG Laser Application to Hyperthermia (T. Nobori)

: Percutaneous Laser Angioplasty for Peripheral (Femoral) Artery (S. Takekawa)

: Biostimulation on Chronic Rheumatoid Arthritis by He-Ne Laser (Y. Oyamada)

: Ruby and Argon Laser Unit with Kaleidoscanner (K. Iwasaki)

: Combined Laser Power Delivery of CO and Nd-YAG Laser by IR Glass Fiber (T. Arai)

: Flexible Hollow Light Guide (Alminum & Teflon) for High Power CO_2 Laser (U. Kobo)

: New Centralized Laser Hospital

1986 : Introduction of Foreign DNA into Cultured Cells by Nd-YAG Laser (S. Kurata)

: Endoscopic Laser Treatment of Gastric Cancer by a Newly Deviced Cylindrical Metallic Probe (H. Kagei, et al.)

: PDT with Eosin Yellow by Argon Laser (S. Shibuya, et al.)

: Computerized Laser Microscanner in Plastic Surgery (N. Nimsakul)

: Nd-YAG Laser Irradiation for Hepatic Tumors under the Laparoscope (T. Katamoto, et al.)

: Laser Angioplasty with Nd-YAG Laser and Vascular Endoscopy (S. Takekawa)

: CO Laser Unit for Angioplasty (T. Arai, et al.)

: Clinical Vascular Anastomosis by CO_2 Low Power Laser (M. Okada)

: Myocardial Revascularization by Laser (M. Okada)

: Automatically Tracing Laser Irradiation System for Moving Target (A. Nagasawa)

1987 : Development of Laser Balloon through Intraportal Vein (Y. Shimamura)

: Laser Iridotomy by Dye Laser (R. Ohki)

: Intradiscal Laser Nucleotomy (T. Yonezawa)

: Percutaneous Laser Nephrolithotomy (Y. Tanahashi)

: Laserlithotripsy by CO Laser (Y. Ohmichi)

: Nephrolithotripsy by Pulsed Dye Laser (I. Numata)

: Photosensitizer for PDT

1) Mono-L-Seryl Chlorin e^6 (Y. Yasunaka)
2) Chloroaluminum Tetrasulphonated Phthalocyanine (K. Kunimi)
3) Zinc Tetrasulphonated Phthalocyanine (T. Nishisaka)
4) Tetracycline (T. Nishisaka)

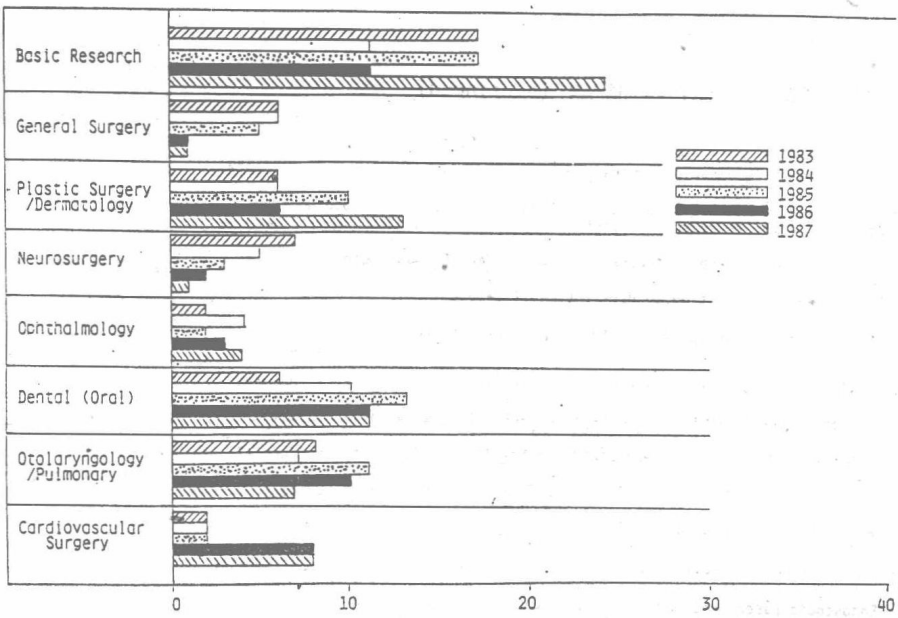

Fig. 1. Classification of the applied medical fields from the reported papers in the annual meeting of Japan Society for Laser Surgery & Medicine. No.1 (1983 - 1987)

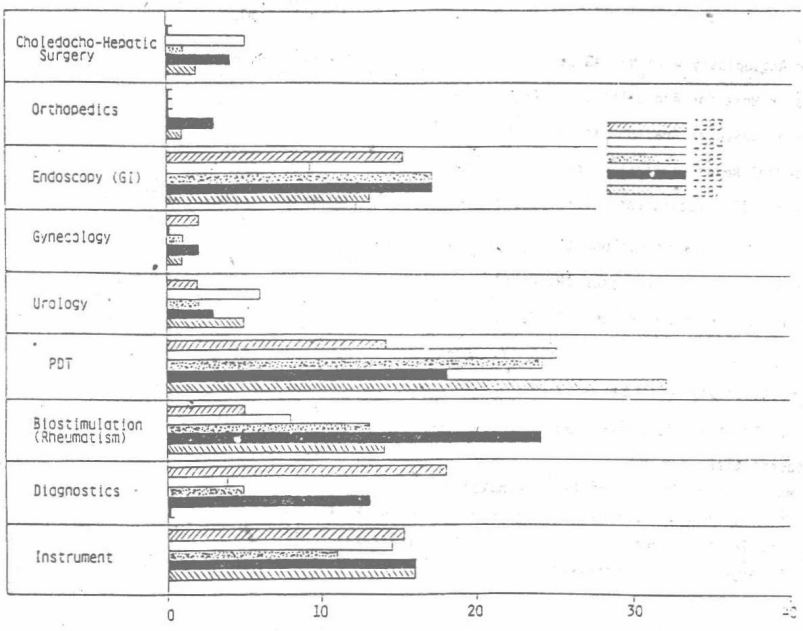

Fig. 2. Classification of the applied medical fields from the reported papers in the annual meeting of Japan Society for Laser Surgery & Medicine. No.2 (1983 - 1987)

THE PRESENT STATE OF LASER SURGERY AND MEDICINE

The Figures(1)(2) show the classification of the applied medical fields from the reported papers in the annual meetings of Japanese society during five years from 1983 to 1987.

In the Figures(1)(2), basic research is large number and dental, plastic surgery and ENT are fairly large. Cardiovascular surgery has been increasing recently. The biggest number is PDT and endoscope, biostimulation and instrument are followed.

At the present state, the clinical fields can be classified according to the maturity as shown in the Figure(3). In the Figure(3), from upside to down, the matured fields to the prematured fields are arranged. Basic research of oncology, orthopedics, dental, cardiovascular fields are the prematured areas.

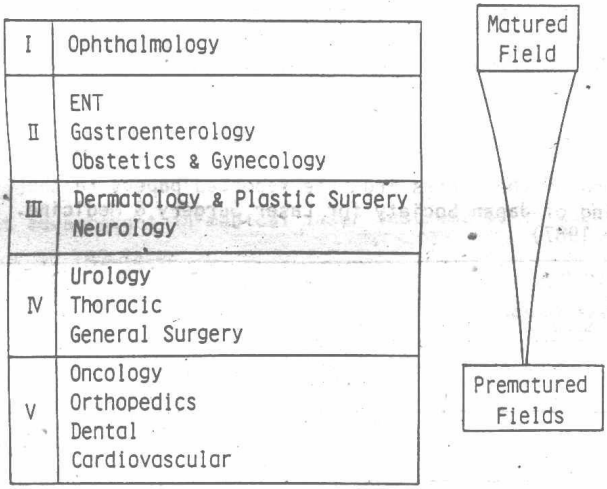

Fig. 3. Maturity of laser surgery.

The Figures(4)(5) show the lasers from the reported papers in Japanese society meetings. In the Figures(4)(5), Nd-YAG laser is the largest number and is increasing recently. CO_2 laser follows and diode laser shows fairly large. Argon dye is large number because of PDT application.

The Table(2) shows laser surgical units installed in the Japanese hospitals in 1986. 230 CO_2 lasers, 170 Nd-YAG lasers and 30 argon lasers were counted. Medical statistics of Japan are indicated as the references.