Application of CO_2 Lasers to Periodontal Therapy

炭酸ガスレーザーによる歯周治療への応用

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Ⅰ. Introduction

Lasers have become widely used in clinical medicine, especially in the fields of ophthalmology and surgery, ever since Maiman[1)] succeeded in oscillating a ruby laser, which is a solid laser. The first attempt at using a laser in the field of dentistry was by Goldman[2)], et al in 1964. In the field of periodontal therapy, research using lasers to irradiate the tooth surface has been conducted to remove calculus at the upper and lower gingival margins and sterilize the teeth, while other research has focused on the suppression of plaque formation using the antibacterial action of lasers. Still other research has examined the use of lasers to destroy endotoxin and treat the root surface[3)].

The effects of lasers and their actions：(1)Heat effect; The temperature at the point of focus of the laser is 1000℃ or more, and tissue can be incised or evaporated. Lasers can also be used to coagulate tissue located at areas away from the focus of the laser. (2)Pressure effect; A laser can perform incisions and so on using its impact pressure, (3) Photo effect; Selective absorption of a substance by using the special characteristics of the wavelength of a mediator upon its oscillation by a laser. (4) Electromagnetic effect; Used for the ionization chemistry of an electromagnetic wave and the destruction of molecular bonds. These 4 showed the effect of a laser effects（Fig. 1）.

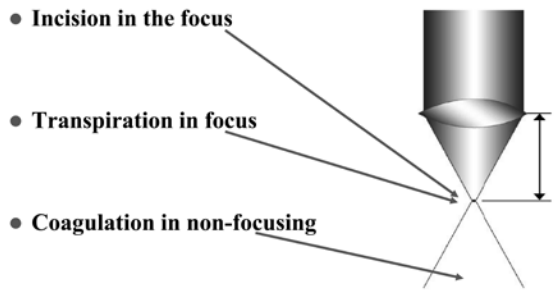

fig. 1 The effect of laser
図１ レーザーの効果

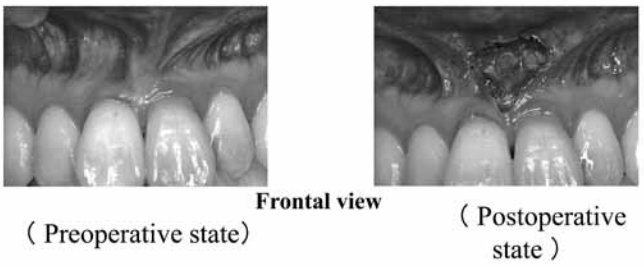

fig. 2 Cases of abnormal upper lip frenulum
図２ 上唇小帯切除の症例

At the present time in the field of dental therapy, lasers are divided into 2 categories depending on their wavelength; soft lasers that have a stimulatory effect and analgesic effect, and hard lasers that are used for incisions, evaporation, or coagulation. Lasers can also be classified into solid and gaseous according to the mediator acted upon by the laser oscillation. Currently, the main lasers used in dental therapy are (1) Semiconductor lasers; Short wavelength of 800 nm, effects are similar to those of lasers (pain alleviation, promotion of healing, etc.). (2) Nd: YGA lasers have a near infrared wavelength of 1064 nm, excellent tissue permeability, and are used to excise tumors, evaporate soft tissues, hemostasis, incisions, analgesia for hyperesthesia, as an anti-inflammatory, melanin elimination, periodontal pocket application, and so on. (3)Er: YAG lasers have a long wavelength of 2940 nm and are used therapeutically to remove plaque and cut teeth. (4) CO_2 lasers: have a far infrared wavelength of 10,600 nm, zero permeability, and strong thermal action. They are used to excise tumors, evaporate soft tissues, hemostasis, incisions, melanin removal, etc. At the present time many lasers are being used in therapy to treat a variety of different diseases.

In the present paper, we discuss the potential for using CO_2 gas lasers in periodontal therapy.

Ⅱ. Periodontal therapy cases

1. Gingival resection, frenectomy

A laser was used to treat an abnormal upper labial frenum attachment. The frenum was resected by evaporation in this patient (Fig. 2). The patient did not experience any bleeding or pain after the procedure. The laser was also used to resect an abnormal lingual frenum attachment (Fig. 3). This patient was a child. The incision was performed with only surface anesthesia and there was no postsurgical bleeding or pain. Preprosthetic imaging margin control was performed in this patient due to gingival margin gingival proliferation in the maxillary premolar area. The laser treatment was applied and resection evaporation was performed (Fig.4). No postsurgical bleeding or pain was observed and it was possible to obtain an impression

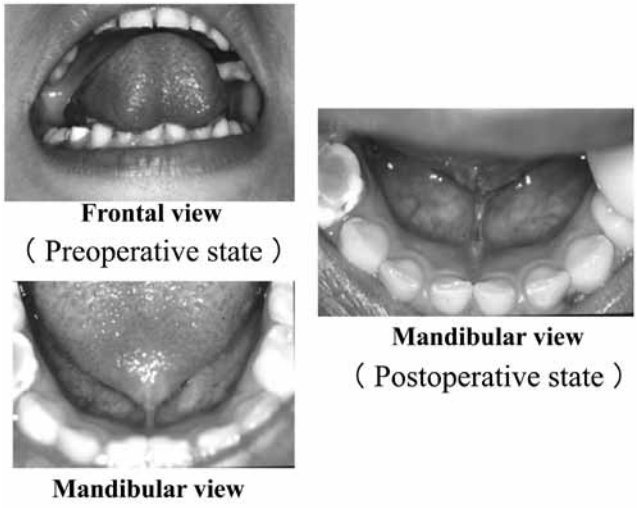

fig. 3 Cases of abnormal lingual frenulum
図３ 舌小帯切除の症例

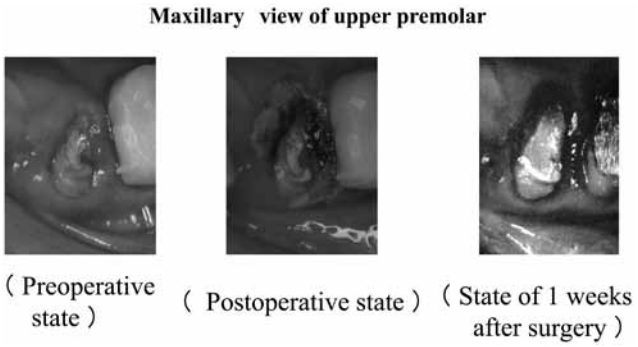

fig. 4 Cases of gingivectomy
図４ 歯肉切除の症例

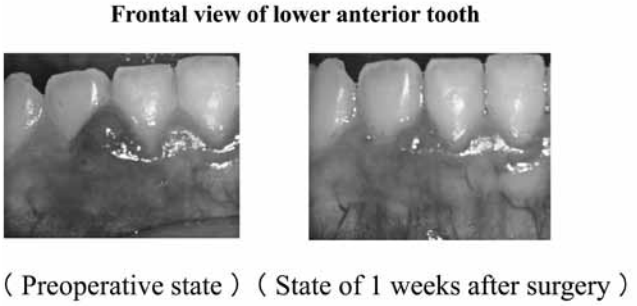

fig. 5 Cases of acute periodontal disease
図５ 急性歯周病の症例

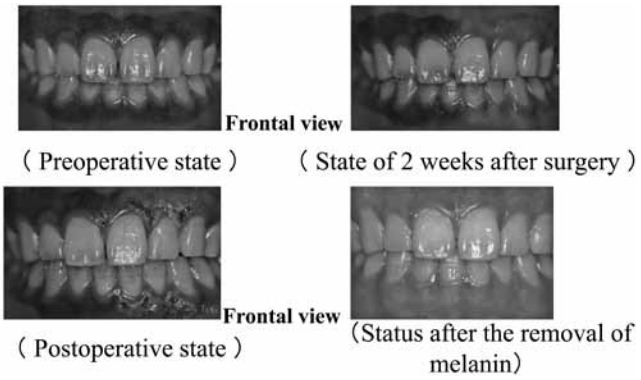

fig. 6 Cases of melanin deposition
図６ メラニン色素沈着の症例

on day 7 after the surgery. Compared to the existing methods for frenum and gingival resection which used an electric scalpel or a phasor scalpel, the present method enabled treatment without anesthesia, the morphology of the frenum gingival could be clearly ascertained, it was easy to control the bleeding due to the incision, and an incision by confirming the exact location was possible. Even after the procedure, the surface of the wound improved rapidly and the time required for healing was shortened.

2. Application to periodontal disease of acute conditions

A laser with only surface anesthesia was used to treat an acute abscess that developed in the manbibular anterior tooth area (Fig.5). No bleeding or pain was observed postsurgically. In acute gingival symptoms, laser irradiation caused pus discharge from the tumor region. Immediately after irradiation, the surface layer coagulated and the control of hemostasis was easy. Almost no pain was seen during and after the surgery. The patient only reported a feeling of warm heat.

3. Application for the removal of gingival pigmentation

The laser was used to treat gingival pigment deposition that existed in the gingiva of the upper and lower jaws. The laser was applied under only surface anesthesia and we continued to apply the laser until evaporation of the calcified layer on the surface of the pigment deposition area (Fig.6). The calcified layer on the surface of the gingival had detached one week postsurgically and the pigment deposition was eliminated. In the elimination of gingival pigment deposition, surgical interventions such as the detachment and resection of gingival epithelia or nonsurgical procedures such as cleaning with 90% phenol alcohol have been employed up until now. Compared to these methods in which pain was experienced by the patient both during and after the operation, virtually no pain was observed during or after the operation with the laser treatment. Furthermore, the deposited pigment could be removed without any anesthesia. However, in cases where the pigment deposition is widely distributed and/or reaches the basal membrane deep layer, it is believed an effective treatment method is to apply the laser irradiation by dividing it into several applications and then removing the remaining deposition with further irradiation. Removal of gingival melanin pigment deposition using a CO_2 gas laser is easy to use from the point of view of the operator, while the patient experiences reduced physical and mental stress and less risk of adverse effects. This indicates that the method is clinically effective for removing melanin pigment deposits from the gingiva. However, postsurgically, the patient requires regular maintenance in order to prevent recurrence of the

problem[4].

4. Application to the treatment of periodontal pockets

This patient presented with chronic marginal periodontitis. Areas with pockets at least 4 mm in depth were irradiated with the laser (Fig.7). Following the laser irradiation, the gingival swelling, rubor, and bleeding that were observed before the treatment had all improved, and together with an improvement in these clinical symptoms, pain alleviation was also noted.

Application of this CO_2 laser irradiation technique to the interior of periodontal pockets is believed to be an effective treatment for the removal of remaining infected granulation tissue on the root surface and treatment of the root surface[5].

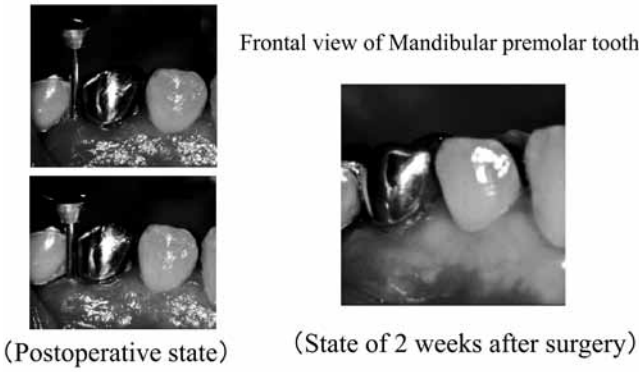

fig. 7 Cases of treatment of periodontal pockets
図7 歯周ポケット治療の症例

Ⅲ. Discussion and Conclusions

These types of applications of lasers to periodontal therapy are presently common and numerous, and therapeutic effects are being observed depending upon the kind of disease. They are one possible therapeutic choice. The pain associated with laser therapy is less compared to other existing dental therapies. However, we must fully understand the special characteristics of each type of laser therapy, and select patients in whom it will be effective and consider its safety when using it. In particular, areas outside the treatment area must be protected since the laser can generate high temperatures of 1000℃ or above. In the future, by performing basic and clinical research, and overcoming various problems such as laser output, duration of laser exposure, and direction of exposure, we should be able to determine the potential for using this technique to treat periodontal diseases.

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Application of CO_2 Lasers to Periodontal Therapy

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In recent years, laser therapy is used for dental treatment, we cited the therapeutic effect by applying the treatment of caries, hypersensitivity treatment, to Periodontal Therapy.

With a wavelength of 10,600 nm far-infrared region, low tissue permeability, and also high heat retention effect, CO_2 laser, is characterized, such as less damage to surrounding tissue other than the treatment site. We will present an overview of the clinical application through the use of CO_2 laser. CO_2 laser application definitive periodontal treatment is applied to the soft tissue in the periodontal tissue is also carried out, and made for the application, such as application and removal of gingival melanin for acute of periodontal tissue

In the future, by performing basic and clinical research, and overcoming various problems such as laser output, duration of laser exposure, and direction of exposure, we should be able to determine the potential for using this technique to treat periodontal diseases.

●抄録● 炭酸ガスレーザーによる歯周治療への応用

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佐藤　　聡　歯学博士　ICDフェロー

レーザー治療が歯科治療に用いられ，う蝕治療，知覚過敏症処置，歯周治療への応用により治療効果を挙げています。CO_2レーザーは，遠赤外線領域10,600nmの波長を持ち，組織透過性が少なく，強い熱作用を持ち，また，治療部位以外の周囲の組織へのダメージが少ないなどの特徴がある。CO_2レーザーの使用による臨床応用の概要を紹介します。

歯周治療におけるCO_2レーザー応用は，歯周組織においても軟組織に対する応用が行われ，歯周組織急性症状に対する応用や歯肉メラニン除去についての応用などを行っております。今後、基礎的、臨床的な研究を行うことで、レーザー出力、時間、照射方向などの問題点を考慮することにより、歯周病に関する処置への新たな可能性が認められ、歯周治療に対する一つの療法への可能性が見られます。

キーワード：CO_2レーザー、歯周病、歯肉切除、歯肉色素沈着、歯周急性症状