Effect of Carbon Dioxide Laser on the Clinical Parameters and Crevicular IL-1β When used as an adjunct to Gingival Flap Surgery

Kyung-Hee Choi

The Graduate School

Yonsei University

Department of Dental Science

Effect of Carbon Dioxide Laser on the Clinical Parameters and Crevicular IL-1β When used as an adjunct to Gingival Flap Surgery

A Dissertation Thesis

Submitted to the Department of Dental Science

and the Graduate School of Yonsei University

in partial fulfillment of the

requirements for the degree of

Master of Dental Science

Kyung-Hee Choi

June 2003

This certifies that the dissertation thesis

of Kyung-Hee Choi is approved.

_____

Thesis Supervisor: Chong-Kwan Kim

_____

Seong-Ho Choi

_____

Yun-Jung Yoo

The Graduate School

Yonsei University

June 2003

감사의 글

아직 부족하지만 많은 분의 도움으로 한편의 논문을 내놓게 되었습니다. 본 논문이 완성되기까지 부족한 저를 항상 따뜻한 관심과 지도로 격려해 주시고 이끌어 주신 김종관 교수님께 깊은 감사를 드립니다. 그리고, 본 연구에 많은 관심과 도움을 주신 최성호 교수님께도 진심으로 감사 드립니다. 또한 많은 조언과 관심으로 지켜봐 주신 채중규 교수님, 조규성 교수님, 김창성 교수님께도 감사 드립니다.

실험 결과 분석에 많은 도움을 주신 최봉규 교수님과 생물학 교실 강정화 선생님께도 감사드립니다.

본 연구 내내 많은 도움을 준 치주과 교실원 여러분과 민아 언니, 그리고 정유에게도 고마운 마음을 전하며, 또한 통계처리에 도움을 주신 명성민 선생님께도 감사의 마음을 전합니다.

모든 분들께 진심으로 감사드립니다.

2003년 6월

저자 씀

Table of Contents

List of Tables and Figures

Abstract

Effect of Carbon Dioxide Laser on the Clinical Parameters and Crevicular IL-1β When used as an adjunct to Gingival Flap Surgery

The objective of the present study was to evaluate the effect of a carbon dioxide (CO_2) laser treatment on the clinical parameters and crevicular Interleukin-1β (IL-1β) levels when used in combination with gingival flap surgery.

Twelve patients with moderate to advanced periodontitis were selected for this study. Three quadrants of each patient were randomly assigned to one of the following study groups: 1) flap surgery only as the (control); 2) flap surgery and laser treatment using an energy level of 0.8 W as (group 1); 3) flap surgery and laser treatment using an energy level of 0.5 W as (group 2). The gingival crevicular fluid (GCF) was collected at the baseline and biweekly for 6 weeks and the amount of IL-1β concentration in sulcular fluid was measured using an enzyme-linked immunosorbent assay (ELISA). The clinical parameters such as the probing pocket depth, the clinical attachment level, the

gingival recession and the bleeding on probing were recorded at baseline, 3, 6 months.

The results were as follows; marked reductions of the bleeding on probing, the probing pocket depth, the clinical attachment level and a reduction in the crevicular IL-1β concentration were found in all groups. However, the differences between the groups in terms of bleeding on probing and the probing pocket depth were not significant ($p<0.05$). The clinical attachment level and the crevicular IL-1β level were significantly lower in group 1 (0.8 W) than in the control ($p<0.05$).

In conclusion, additional use of a Carbon Dioxide laser on the root surface during gingival flap surgery may enhance the clinical attachment and reduce crevicular IL-1β concentration.

Key words : Carbon dioxide laser; periodontitis; gingival flap surgery; interleukin-1β; clinical attachment level

Effect of Carbon Dioxide Laser on the Clinical Parameters and Crevicular IL-1β When used as an adjunct to Gingival Flap Surgery

Kyung-Hee Choi, D.D.S.
Department of Dental Science, Graduate School,
Yonsei University
(Directed by Prof. Chong-Kwan Kim, D.D.S., M.S.D., PhD.)

Ⅰ. Introduction

Removing calcified deposits, microorganisms, microbial products from a diseased root surface is essential in periodontal therapy in order to achieve biologically acceptable root surface (Zander *et al*., 1976; Patters *et al*., 1982; O'Leary, 1986). Scaling and root planing are widely used for such purposes.

It is difficult to completely remove plaque and calculus by scaling and root planing with or without surgical access (Jones and O'Leary, 1978; Waerhaug, 1978; Stambaugh *et al*., 1981; Buchanan and Robertson, 1987; Kepic *et al*., 1990). The remaining calculus may act as a foundation for bacterial recolonization and the accumulation of metabolic by-product. This type of

microbial growth caused bad result in therapeutic aspect and can be the cause of a recurrence of the disease and a failure of the therapy (Waerhaug, 1978; Patters *et al*., 1982). Therefore, there needs to be a more effective means of removing residual plaque and calculus. Some reports suggested using lasers in addition to the conventional scaling and root planing (Iwase *et al*., 1989; Myers, 1991). In theory, it is possible to remove the residual organic debris including microbial plaque and calculus without causing any damage to the adjacent root surfaces with a laser.

The most widely used lasers in dentistry are the CO_2 laser, the Nd:YAG laser, the Er:YAG laser and the argon laser. Lasers have several uses to periodontal treatment such as sterilization by the ablation of the dental deposits and root conditioning by the ablation of the diseased root surface.

Several researchers have reported the application of laser in periodontal therapy. White et al. (1991) and Cobb et al. (1992) suggested the laser as an adjunctive procedure for periodontal treatment. They reported that a laser could remove calculus and be used in subgingival root planing. In addition, it was reported that the number of periodontal pathogens were reduced and Yamaguchi et al. (1997) reported the elimination of endotoxin.

Besides these effects, it has also been reported that the laser radiation effectively exposes the dentinal tubules by removing the smear layer which is related to the attachment of the connective tissue. Morlock et al. (1992) showed that when a laser was used together with conventional root planing, the smear layer that was observed when root planing alone was performed was eliminated and the dentinal tubules were effectively exposed. Ito et al. (1993) also reported the exposure of the dentinal tubules and collagen fibers.

Interleukin-1 (IL-1) is one of the cytokines produced by the activated mononuclear phagocytes derived from the peripheral blood or tissue and the β form has an important catabolic effect on the bone tissue (Grower *et al*., 1983; Gowen and Mundy, 1986).

Some reports have shown that interleukin-1β (IL-1β) plays a crucial role in the destruction of the periodontal tissues (Page, 1991; Stashenko *et al*., 1991; Jandinski *et al*, 1991). IL-1β is found in the periodontal tissue and gingival crevicular fluid (GCF) of patients with periodontal disease (Charon *et al*., 1982; Mergenhagen, 1984; Masada *et al*., 1990; Wilton *et al*., 1992) and its levels decrease after the appropriate treatment (Honig *et al*., 1989; Masada *et al*., 1990; Hou *et al*., 1995). It was reported that there is a correlation between the total amount of crevicular IL-1β concentration and both the gingival index

and the probing depth (Hou *et al*., 1995; Liu *et al*., 1996). These findings suggest that measuring the total amount of crevicular IL-1β level is very useful for monitoring the periodontal disease activity.

The purpose of this study was to evaluate the effects of a carbon dioxide laser treatment on the root surfaces when used in combination with traditional gingival flap surgery using different power levels by measuring the crevicular interleukin-1β level and several other clinical parameters in patients diagnosed with adult periodontitis.

Ⅱ. Materials & methods

A. Clinical Sampling and Design

Twelve patients (5 males and 7 females) ranging from ages 29 to 52 years of age (mean: 44 years) with moderate to advanced periodontitis were selected for periodontal treatment at the Dept. of Periodontics, Dental Hospital, Yonsei University Medical Center. Informed consent was obtained from all participants. The criteria for patient selection were: 1) no history of periodontal therapy within 6 months; 2) at least 3 sites with a probing depth of 4 mm or more in each quadrant; 3) the first premolar, second premolar, first molar were retained in each of the 3 quadrants. GCF samples were collected from the site with greatest initial pocket depth of the quadrant for IL-1β analysis. Thirty-six quadrants from 12 patients were examined and three quadrants from each patient were randomly assigned to one of the following study groups: 1) flap surgery only (control); 2) flap surgery and laser treatment using an energy level of 0.8 W (group 1); 3) flap surgery and laser treatment using an energy level of 0.5 W (group 2).

Scaling and basic oral hygiene education including instructions in tooth brushing, flossing and the use of an interdental brush were given at the start of the study and the instructions were reinforced at all subsequent visits. The clinical parameters such as the probing pocket depth, the clinical attachment level, the gingival recession and the bleeding on probing were recorded at the baseline (1 month after scaling), 3 and 6 months and the GCF samples were collected at the baseline and biweekly for 6 weeks (Table 1).

Table 1. Flow diagram showing the experimental procedure

Baseline	2 week	4 week	6 week	3 month	6 month
PD				PD	PD
Rec				Rec	Rec
CAL				CAL	CAL
BOP				BOP	BOP
GCF	GCF	GCF	GCF		

PD: Pocket depth Rec: Recession CAL: Clinical attachment loss

BOP: Bleeding on probing GCF: Gingival crevicular fluid

B. Clinical Parameters

1. Bleeding on probing

The presence or absence of bleeding was recorded 5 seconds after removing the periodontal probe when measuring the pocket depth and attachment level. The proportion of the bleeding points out of the total number of points examined was calculated.

2. Probing pocket depth and probing attachment level

The probing pocket depth and the probing attachment level were measured to the nearest of 1 mm using a Marquis color corded probe (0.5 mm in diameter). During probing, the probe was directed to the long axis of the tooth. The probe was moved twice towards the base of the pocket to find the pocket base. The distance from the pocket base to the gingival margin (probing pocket depth) and to the cementoenamel junction (probing attachment level) was recorded.

3. Gingival recession

The location of the gingival margin was assessed by subtracting the figure for the pocket depth from the figure for the attachment level.

C. Surgical Procedure

Gingival flap surgery was employed in one side of the 3 quadrants. The two remaining quadrants were treated with a gingival flap surgery and 0.8 W/ 0.5 W CO_2 laser irradiation to the root surface after root planing. The char layer was eliminated through curettage after the laser irradiation. The wound was covered with a periodontal dressing§. The patients were instructed to rinse with a 0.2% chlorhexidine digluconate solution twice daily during the first 2 weeks after surgery. They were then recalled every 2 weeks for professional tooth cleaning as described by Axelsson and Lindhe (1974).

---

§ Coe Pak™, GC America Inc, USA

D. Application of Laser

The laser-treated sites were irradiated with a CO2 laser† using a focused beam (2 mm from target surface), a 0.4 mm diameter focal spot, wavelength of 10.6 ㎛. The laser parameters were 0.8 W (group 1) / 0.5 W (group 2) of power delivered at 50 Hz in a continuous mode. The contact optic fiber was held parallel to the root surface and moved in a back and forth motion in order to cover the entire root surface with overlapping strokes until a confluent char layer could be seen. The laser was irradiated on the alveolar bone adjacent to the root surface and the flap. When using the laser, of the smoke needs to be eliminated effectively and it is recommended that both the patient and the operator wear protective glasses to reduce the risk of eye damage, as a result of the laser and the refraction of the beam.

---

† OPELASER O3SII, Yoshida Dental MFG. CO., Japan.

E. Collection and Assay of IL-1β

The GCF samples were collected by inserting paper strips‡ into the gingival crevice until mild resistance was felt. The paper strips were kept in place for 30 seconds (Wilton *et al*., 1992). The fluid was sampled from a single site in each quadrant where the pocket depth measured 5-6 mm. The fluid was collected from the same site 2,4 and 6 weeks after surgery. Each paper strip was then placed in 100 ㎕ of Hank's buffered salt solution (HBSS) containing 0.5% bovine serum albumin, and stored frozen at -80℃ until needed. The amount of IL-1β levels in the GCF sample were assessed by an enzyme-linked immunosorbent assay (ELISA) with a recombinant IL-1β monoclonal antibodies¶. All the assay procedures were carried out according to the manufacturer's protocol and the optical densities were measured using a spectrophotometer at 450 nm.

---

‡ Periopaper, HARCO Electronics, Irvine, CA.

¶ Biotrak, Amersham Pharmacia Biotech UK Limited.

F. Statistical Analysis

A one-way ANOVA with a Tukey's test was used to determine the statistical significance of the IL-1β levels and the clinical parameters between the different treatment groups at the baseline and at indicated time points after treatment. Repeated Measures ANOVA was used to determine the statistical significance of the IL-1β level and the clinical parameters within the groups in comparison to the baseline

Ⅲ. Results

A. Bleeding on probing

The percentage of the bleeding on probing decreased in all of the groups after the treatment. The baseline of the percentage of bleeding on probing were 80.2±19.9%, 76.2±21.5%, 86.8±21.4% respectively in group 1, group 2 and the control, respectively. It was 9.7±9.2%, 8.7±8.6%, 19.1±9.4% after 3 months and 13.6±5.2%, 15.1±4.2%, 17.5±4.8% after 6 months of treatment, respectively showing a consistent decrease every month after the treatment ($p<0.05$). However there were no differences among the 3 treatment groups ($p>0.05$). (Table 2, Figure 1)

Table 2. Bleeding on probing (%)

	Baseline	3 months	6 months
Group 1	80.2±19.9	9.7±9.2 *	13.6±5.2 *
Group 2	76.2±21.5	8.7±8.6 *	15.1±4.2 *
Control	86.8±21.4	19.1±9.4 *	17.5±4.8 *

Data are represented as the proportion of bleeding site out of the total number of examined sites (%)

* Statistically significant differences compared to baseline ($p<0.05$).

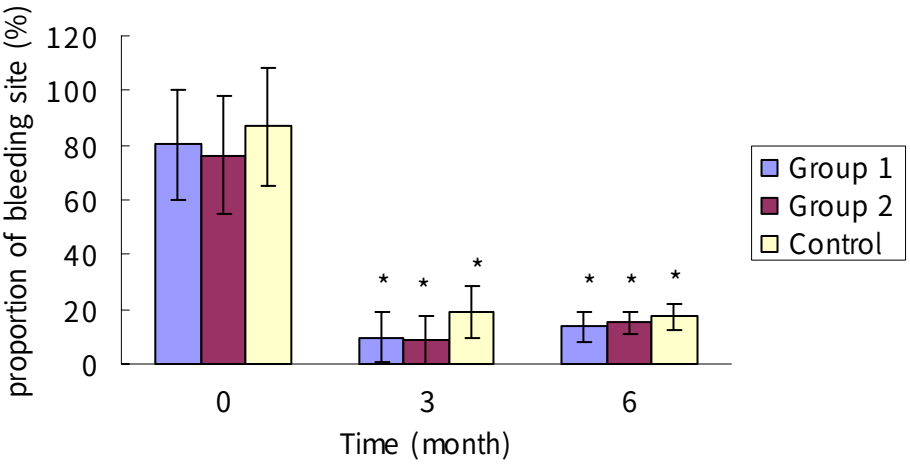

Figure 1. Bleeding on probing (%)

* Statistically significant differences compared to baseline (p<0.05).

B. Probing pocket depth

The probing pocket depth also decreased in all of the groups after 3 and 6 months after treatment. The baseline pocket depth was 5.0±0.6 mm, 5.2±0.6 mm, and 4.8±0.5 mm respectively in group 1, group 2 and the control respectively. It was 2.5±0.3 mm, 2.5±0.4 mm, and 2.6±0.3 mm respectively, with an approximately 2.3-2.6 mm decrease in the pocket depth after 3 months and it was 2.6±0.3 mm, 2.6±0.4 mm, and 2.8±0.3 mm respectively showing an approximately 2.1-2.6 mm decrease in the pocket depth after 6 months. All of

the groups showed a consistent decrease after the treatment. However there were no differences among the 3 groups (p>0.05). (Table 3, Figure 2)

Table 3. Probing pocket depth (mm)

	Baseline	3 months	6 months
Group 1	5.0±0.6	2.5±0.3 *	2.6±0.3 *
Group 2	5.2±0.6	2.5±0.4 *	2.6±0.4 *
Control	4.8±0.5	2.6±0.3 *	2.8±0.3 *

* Statistically significant differences compared to baseline (p<0.05).

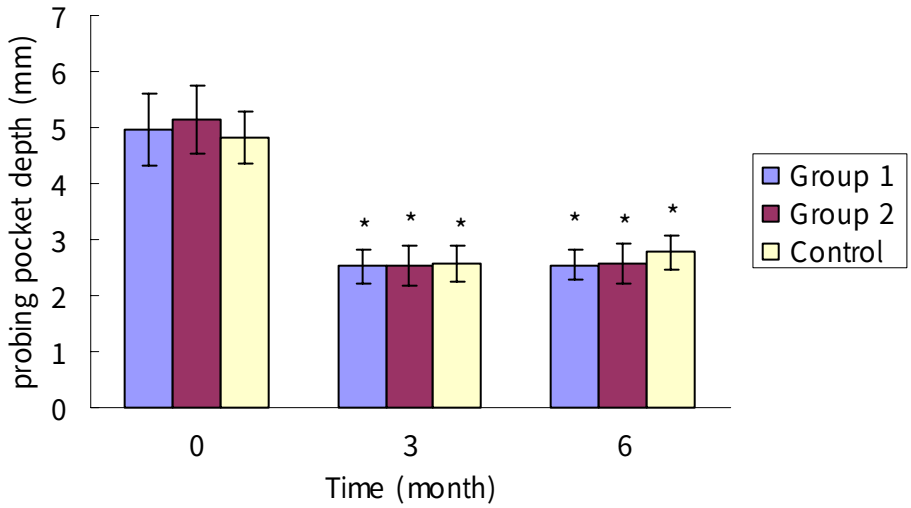

Figure 2. Probing pocket depth (mm)

* Statistically significant differences compared to baseline (p<0.05).

C. Clinical attachment level

The clinical attachment level in all the groups decreased after 3 and 6 months after treatment consistently compared to the baseline. The results after 3 months were 3.2±1.0 mm for group 1, 3.5±1.3 mm for group 2 and 3.8±1.3 mm for the control. Group 1 and the control showed statistically significant differences in attachment gain ($p<0.05$), while there were no differences between group 2 and the control as well as between group 1 and group 2 ($p>0.05$). It was 3.3±1.0 mm, 3.7±1.4 mm and 4.0±1.3 mm in group 1, group 2 and the control after 6 months, respectively and group 1 and the control showed statistically significant differences ($p<0.05$), but there were no differences between group 2 and the control, group 1 and group 2 ($p>0.05$). (Table 4, Figure 3)

Table 4. Clinical attachment level (mm)

	Baseline	3 months	6 months
Group 1	5.3±0.8	3.2±1.0 * †	3.3±1.0 * †
Group 2	5.5±0.7	3.5±1.3 *	3.7±1.4 *
Control	5.0±0.5	3.8±1.3 *	4.0±1.3 *

* Statistically significant differences compared to baseline ($p<0.05$).

† Statistically significant differences compared to control ($p<0.05$).

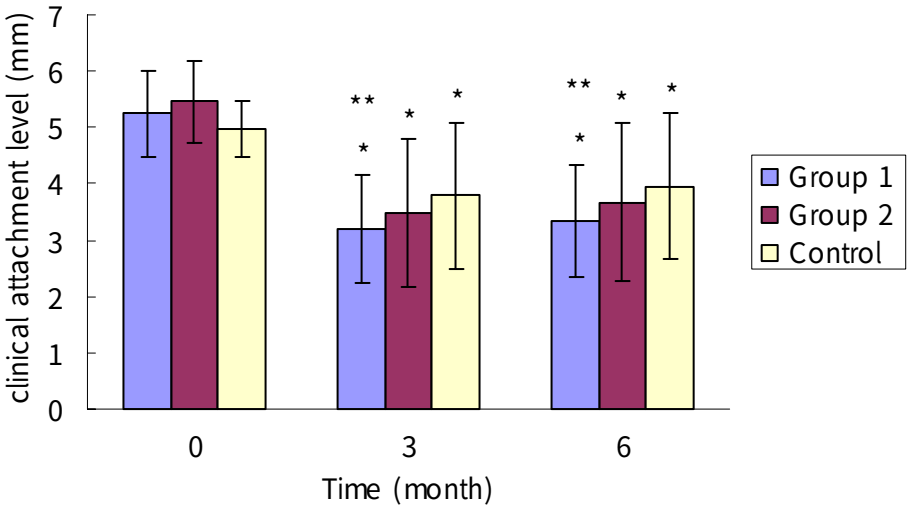

Figure 3. Clinical attachment level (mm)

* Statistically significant differences compared to baseline (p<0.05).

** Statistically significant differences compared to control (p<0.05).

D. Concentration of IL-1β in crevicular fluid

The crevicular IL-1β levels prior to the treatment for group 1, group 2 and the control were 174.6±34.2 pg/ml, 136.1±54.1 pg/ml and 188.5±92.7 pg/ml respectively. However there was a decrease after 2,4 and 6 weeks of treatment in all of the groups (p<0.05). When comparing each group according to time, there was a similar difference between group 1 and the control after 2,4 and 6 weeks of treatment, whereas there were no similar differences between group 2 and the control, and group 1 and group 2 (p>0.05). (Table 5, Figure 4)

Table 5. Changes of crevicular IL-1β (pg/ml) from baseline to 6 weeks

	Baseline	2 weeks	4 weeks	6 weeks
Group 1	174.6±34.2	22.5±14.9 * †	28.5±29.0 * †	20.3±24.4 * †
Group 2	136.1±54.1	70.8±53.2 *	64.0±49.9 *	49.9±29.9 *
Control	188.5±92.7	110.2±72.1 *	98.2±64.5 *	82.6±43.4 *

* Statistically significant differences compared to baseline (p<0.05).

† Statistically significant differences compared to control (p<0.05).

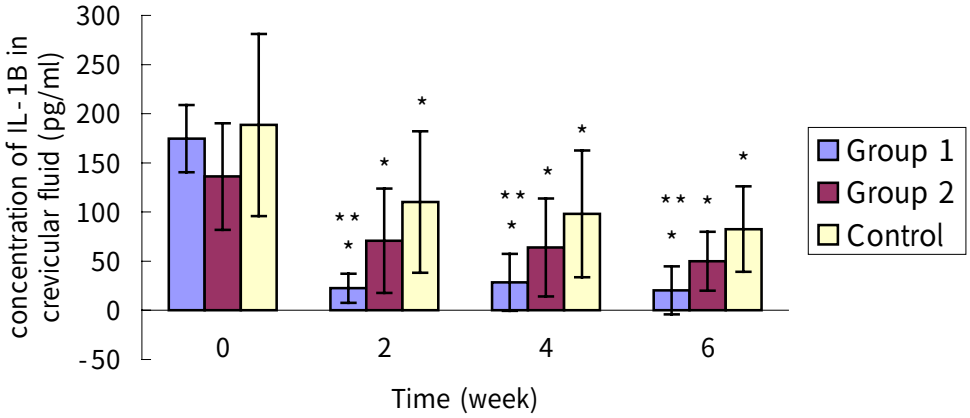

Figure 4. Concentration of IL-1β in crevicular fluid (pg/ml)

* Statistically significant differences compared to baseline (p<0.05).

** Statistically significant differences compared to control (p<0.05).

Ⅳ. Discussion

The purpose of periodontal therapy is to make a regeneration of the connective tissue of the root surface with periodontitis in order to reproduce the periodontal tissue to allow the tooth to function normally. However, conventional scaling and root planing have some limitation in making a regeneration because it is difficult to completely eliminate plaque and calculus from the root surface. For this matter, alternatives have been examined in order to compensate for the limitations inherent in mechanical root therapy. Recently, lasers have been recommended as an alternative or adjunctive therapy in the periodontally diseased root surfaces (Iwase *et al*., 1989; Myers, 1991; White *et al*., 1991; Cobb *et al*., 1992). It has been suggested that a laser might be capable of sterilizing the diseased root surface and thus, and ultimately promote cell reattachment (Myers, 1992).

There have been studies comparing root planing and laser in vivo (Cobb *et al*., 1992; Ito *et al*., 1993) but there are few studies investigating the effect of the laser used in gingival flap surgery.

Myers et al.(1992) reported that at energy levels of 50 mJ or more, the melting temperature of hydroxyapatite (700℃) is reached, evaporation begins,

steam forms and microexplosions occur. A series of related studies published in 1992 evaluated the effects of Nd:YAG irradiation on root specimens in vitro (Morlock *et al*., 1992; Spencer *et al*., 1992; Trylovich *et al*., 1992). Collectively, they reported that energy levels of 80 mJ or more resulted in the formation of craters, melting and resolidification of the surface mineral, carbonization, surface porosity and peeling of the cementum. The power of the laser used in this study was 0.5 W and 0.8 W. The power recommended by the manufacturer was 0.8 W. The laser was irradiated approximately 5 times back and forth per second. Therefore, if the laser were irradiated for 0.2 second with an energy level being 0.8 W, it would be approximately 160 mJ, and 100 mJ for 0.5 W. According to a previous study, this is the amount that causes change in the root surface, which is less than what the product company recommended. Therefore, this study aimed to determine if there were any effects of a lower energy level as well. Therefore, laser used with a 0.5 W power was also used in the experimental group.

The results evaluated by measuring the changes in the clinical parameters. There was a decrease in the percentage of bleeding on probing, the decrease in pocket depth, and a gain of clinical attachment level in all of the 3 groups –

group 1, group 2 and control after 3 and 6 months of treatment and a decrease in the crevicular IL-1β levels after 2,4 and 6 weeks of treatment.

Bleeding on probing is a significant clinical factor demonstrating an inflammatory lesion in the base of the connective tissue of the gingival crevice (Meitner *et al*., 1999). In addition, this has been acknowledged by many investigators (Hancock, 1981; Polson and Caton, 1985) that gingival bleeding acts as an indicator of the activity of the periodontal diseases. In this study, the percentage of those exhibiting bleeding on probing decreased in all of the groups after 3 and 6 months of treatment but there were no differences among the groups.

The decrease in the pocket depth and the gain in the clinical attachment level play an important role in evaluating a successful treatment in patients with periodontitis. Kaldahl et al. (1988) reported that there was an average of 2.39 mm decrease in the periodontal pocket depth 3 months after flap surgery in a patient with periodontitis with a pocket depth of 5-6 mm. Becker et al. (1988) also reported that there was an average of 1.78 mm decrease, 6 months after the flap surgery in a patient with periodontitis with a pocket depth of 4-6 mm. In this study, there was a 2.26 mm and 2.05 mm decrease in the control group 3 and 6 months after the flap surgery, respectively, which was a similar

to the result reported in precious studies. There was a decrease of 2.44 mm, 2.62 mm after 3 months and 2.41 mm, 2.58 mm after 6 months in the groups using the laser with 0.8 W, 0.5 W, which showed no statistical difference from the control group. For the clinical attachment level, there was a decrease after 3 and 6 months compared to the baseline in all of the groups and in a comparison of the groups, there was a greater decrease statistically in the 0.8 W laser group than the flap surgery only group. This shows that there is no difference in the pocket depth, but there is a greater gain in the new attachment level when the 0.8 W laser is used compared to the flap surgery alone.

These results were different from the previous studies. Trylovich et al. (1992) reported that when using 80 mJ Nd:YAG laser on an endotoxin-treated root surface, the laser changed the biocompatibility of the cementum surface and prohibited fibroblast attachment. Gopin et al. (1997) in a histological study reported that there was a decrease in soft tissue attachment on the root surface treated with CO_2 laser in histologic study. These results seem to be due to the char layer after laser irradiation.

The intense, localized heat produced when the laser comes into contact with surface debris, organic materials or a pigmented surface causes the charring. It includes remnants of ammonia, cyanate and cyanamide. It appears

that the residual char layer is a significant barrier to soft tissue reattachment. Trylovich et al. (1992) reported that in the case of a char layer in vitro, there was a suppression of fibroblast attachment. Thomas et al. (1994) reported that there was a fibroblast attachment when root planing and an air-powder abrasive slurry were used on the lased root surface in vitro.

In this study, considering the results of a previous study, the char layer on the laser-treated root surface was eliminated by curettage. However, caution should be taken so as not to remove excessive cementum and dentin but to only remove the char laser gently. During the process of eliminating the char layer, it might also be effective in eliminating the areas with incomplete curettage.

It is believed that one of the reasons that the laser-treated group had a greater gain in clinical attachment than the control group is due to accessibility. Irradiating the laser on a narrow intrabony defect where the curette cannot be accessed can have both a mechanical and antibacterial effect.

Theoretically, a laser can eliminate plaques and calculus by ablating and vaporizing them, have access to spots where the instruments cannot reach and disinfect the pocket sulcular lining (Cobb *et al*., 1992; Morlock *et al*., 1992; Ando *et al*., 1996). This notion appears to be supported by our findings in that

laser (0.8 W) combined flap surgery (group 1) produces more reduction in the crevicular IL-1β and gain in clinical attachment than flap surgery only (control). The 0.5 W laser irradiation had a more decreasing effect than flap surgery only, but there did not appear to be sufficient difference.

In this study, the IL-1β levels were significantly lower following CO_2 laser (0.8 W) irradiation combined with flap surgery procedure than flap surgery only. Conflicting results have been reported regarding the effect of periodontal treatment on the IL-1β levels. Some studies have demonstrated that the crevicular IL-1β levels decreased remarkably after basic periodontal therapy (Masada *et al*., 1990; Hou *et al*., 1995; Honig *et al*., 1995). However, Reinhardt et al. (1993) reported no significant differences in the IL-1β levels after scaling and root planing in addition to significant increases after periodontal surgery. The reasons for the difference between the different studies remains to be determined.

Liu et al. (1990) also reported that in terms of the IL-1β decrease, there were no differences between the 2 groups i.e. the group that had scaling and root planing performed and the group that used laser additionally after scaling and root planing. Miyazaki et al. (2003) reported that the Nd:YAG laser alone was as effective as ultrasonic scaling alone in reducing the crevicular IL-1β

levels. However, the CO_2 laser treatment had a lesser effect on removing subgingival plaque and reducing the IL-1β level. This is because the CO_2 laser was used in a non-contact mode, superficially over the gingival tissue.

In conclusion, this study demonstrated that a CO_2 laser (0.8 W) combined with flap surgery produces a greater reduction in the crevicular IL-1β level and clinical attachment loss than flap surgery alone.

Ⅴ. Conclusion

The objective of the present study was to evaluate the effect of CO_2 laser treatment on the clinical parameters and crevicular IL-1β level when used in combination with gingival flap surgery. 36 quadrants from twelve patients were examined and 3 quadrants of each patient were randomly assigned to one of the 3 groups. The experimental groups received laser irradiation at 0.8 W/ 0.5 W in combination with conventional gingival flap surgery and control group received gingival flap surgery only. The results are as follows.

1. The bleeding on probing decreased in all of the groups after treatment. There were no differences among the 3 groups.
2. The pocket depth reduced in all of the groups after treatment. All of the groups showed a consistent decrease after treatment and no significant difference was found among the 3 groups.
3. The clinical attachment level decreased in all of the groups. When comparing each group, 0.8 W laser combined group showed significant decrease comparable to flap surgery only group.
4. When comparing in the crevicular IL-1β level each group according to time, 0.8 W laser combined group showed significant decrease

comparable to flap surgery only group at 2,4 and 6 weeks after treatment.

These results suggest that using 0.8 W CO_2 laser additionally on root surface during the gingival flap surgery has effect on gain of clinical attachment and decrease of IL-1β level.

References

Ando Y, Aoki A, Watanabe H, Ishikawa I: Bactericidal effect of erbium YAG laser on periodontal bacteria. *Lasers Surg Med* 19: 190-200, 1996.

Axelsson P, Lindhe J: The effect of a preventive programme on dental plaque, gingivitis and caries in schoolchildren. Results after one and two years. *J Clin Periodontol* 1: 126-138, 1974.

Becker W, Becker BE, Ochsenbein C: A longitudinal study comparison scaling, osseous surgery and modified Widman procedures. Results after one year. *J Periodontol* 59: 351-365, 1988.

Buchanan SA, Robertson PB: Calculus removal by scaling/root planing with and without surgical access. *J Periodontol* 58: 159-163, 1987.

Charon JA, Luger TA, Mergenhagen SE, Oppenheim S: Increased thymocyte activating factor in human gingival fluid during gingival inflammation. *Infect Immun* 38: 1190-1195, 1982.

Cobb CM, McCawley TK, Killoy WJ: A preliminary study on the effects of the Nd:YAG laser on root surfaces and subgingival microflora in vivo. *J Periodontol* 63: 701-707, 1992.

Gopin BW, Cobb CM, Rapley JW, Killoy WJ: Histologic evaluation of soft tissue attachment to CO_2 laser-treated root surfaces: An in vivo study. *Int J*

Periodont Rest Dent 17: 317-325, 1997.

Gowen M, Mundy GR: Action of recombination interleukin-1, interleukin-2, and interferon on bone resorption in vitro. *J Immunol* 136: 2478-2482, 1986.

Gowen M, Wood DD, Ihrie EJ, McGuire MKB, Russell RGG: An interleukin-1 like factor stimulates bone resorption in vitro. *Nature* 306: 378-379, 1983.

Hancock EB: Determination of periodontal disease activity. *J Periodontol* 52:492-499, 1981.

Honig J, Rordorf-Adam C, Siegmund C, Wiedemann W, Erard F: Interleukin-1 beta(IL-1β) concentration in gingival tissue from periodontitis patients and healthy control subjects. *J Periodont Res* 24:362-367, 1989.

Hou LT, Liu CM, Rossomando EF: Crevicular interleukin-1β in moderate and severe periodontitis patients and the effect of phase I periodontal treatment. *J Clin Periodontol* 22: 162-167, 1995.

Ito K, Nishikata J, Murai S: Effects of Nd:YAG laser radiation on removal of a root surface smear layer after root planing: A scanning electron microscopic study. *J Periodontol* 64: 547-552, 1993.

Iwase T, Saito T, Nara Y, Morioka T: Inhibitory effect of He-Ne laser on dental plaque deposition in hamsters. *J Periodont Res* 24: 282-287, 1989.

Jandinski JJ, Stashenko P, Feder LS: Localization of interleukin-1β in human periodontal tissue. *J Periodontol* 62: 26-43, 1991.

Jones WA, O'Leary TJ: The effectiveness of in vivo root planing in removing bacterial endotoxin from the roots of periodontally involved tooth. *J Periodontol* 49: 337-342, 1978.

Kaldahl WB, Kalkwarf KL, Patil KD: Evaluation of four modalities of periodontal therapy. Mean probing depth, probing attachment level and recession changes. *J Periodontol* 59: 783-793, 1988.

Kepic TJ, O'Leary TJ, Kafrawy AH: Total calculus removal: An attainable objective? *J Periodontol* 61: 16-20, 1990.

Liu CM, Hou LT, Wong MY, Lan WH: Comparison of Nd:YAG laser versus scaling and root planing in periodontal therapy. *J Periodontol* 70: 1276-1282, 1999.

Liu CM, Hou LT, Wong MY, Rossomando E: Relationships between clinical parameters, interleukin-1β and histopathologic findings of gingival tissue in periodontitis patients. *Cytokine* 8: 161-167, 1996.

Masada MP, Persson R, Kenney JS, Lee SW, Page RC, Allison AC: Measurement of interleukin-1α and -1β in gingival crevicular fluid: Implications for the pathogenesis of periodontal disease. *J Periodont Res* 25: 156-163, 1990.

Meitner SW, Zander HA, Iker HP, Polson AM: Identification of inflamed gingival surfaces. *J Clin Periodontol* 6: 93-97, 1979.

Mergenhagen SE: Thymocyte activating factors in human gingival fluids. *J Dent Res* 63: 461-464, 1984.

Miyazaki A, Yamaguchi T, Nishikata J, Okuda K, Suda S, Orima K, Kobayashi T, Yamazaki K, Yoshikawa E, Yoshie H: Effects of Nd:YAG and CO_2 laser treatment and ultrasonic scaling on periodontal pockets of chronic periodontitis patients. *J Periodontol* 74: 175-180, 2003.

Morlock BJ, Pippin DJ, Cobb CM, Killoy WJ, Rapley JW: The effect of Nd:YAG laser exposure on root surfaces when used as an adjunct to root planing: an in vitro study. *J Periodontol* 63: 637-641, 1992.

Myers TD: Lasers in dentistry. *J Am Dent Assoc* 122: 47-50, 1991.

Myers TD: What lasers can do for dentistry and you. *Dent Manage* 29: 26-28, 1992.

O'Leary TJ: The impact of research on scaling and root planing. *J Periodontol* 57: 69-75, 1986.

Page RC: The role of inflammatory mediators in the pathogenesis of periodontal disease. *J Periodont Res* 26: 230-242, 1991.

Patters MR, Landesberg RL, Johansson LA, Trummel CL, Robertson PB: Bacteroides gingivalis antigens and bone resorbing activity in root surface fractions of periodontally involved teeth. *J Periodont Res* 17: 122-130, 1982.

Polson AM, Caton JG: Current status of bleeding in the diagnosis of

periodontal disease. *J Periodontol* 56(suppl): 1-7, 1985.

Reinhardt RA, Masada MP, Kaldahl WB, et al: Gingival fluid IL-1 and IL-6 levels in refractory periodontitis. *J Clin Periodontol* 20: 225-231, 1993.

Spencer P, Trylorich DJ, Cobb CM: Chemical characterization of lased root surfaces using Fourier transform infrared photoacoustic spectroscopy. *J Periodontol* 63: 633-636, 1992.

Stambaugh RV, Dragoo M, Smith DM, Carasali L: The limits of subgingival scaling. *Int J Periodontics Restorative Dent* 1: 31-41, 1981.

Stashenko P, Jandinski JJ, Fukiyoshi P, Rynar J, Socransky SS: Tissue levels of bone resorptive cytokines in periodontal disease. *J Periodontol* 62: 504-509, 1991.

Thomas D, Rapley JW, Cobb CM, Spencer P, Killoy WJ: Effects of the Nd:YAG laser and combined treatments on fibroblast attachment to root surfaces. *J Clin Periodontol* 21: 38-44, 1994.

Trylovich DJ, Cobb CM, Pippin DJ, Spencer P, Killoy WJ: The effects of the Nd:YAG laser on in vitro fibroblast attachment to endotoxin-treated root surfaces. *J Periodontol* 63: 626-632, 1992.

Waerhaug J: Healing of the dento-epithelial junction following subgingival plaque control. II. As observed on extracted teeth. *J Periodontol* 49: 119-134, 1978.

White JM, Goodis HE, Rose CM: Nd:YAG pulsed infrared laser for treatment root surface. *J Cal Den Ass* 19: 55-58, 1991.

Wilton JMA, Bamptom JLM, Griffiths GS: Interleukin-1 beta levels in gingival crevicular fluid from adults with previous evidence of destructive periodontitis. A cross sectional study. *J Clin Peirodontol* 19: 53-57, 1992.

Yamaguchi H, Kobayashi K, Osada R, Sakuraba E, Nomura T, Arai T, Nakamura, J: Effects of irradiation of an erbium:YAG laser on root surfaces. *J Peiodontol* 68: 1151-1155, 1997.

Zander HA, Polson AM, Heijl LC: Goals of periodontal therapy. *J Periodontol* 47: 261-266, 1976.

Clinical photos (Ⅰ)

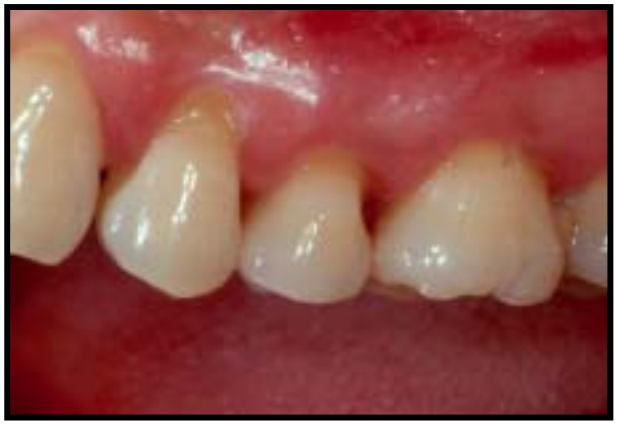

Figure 5-a.

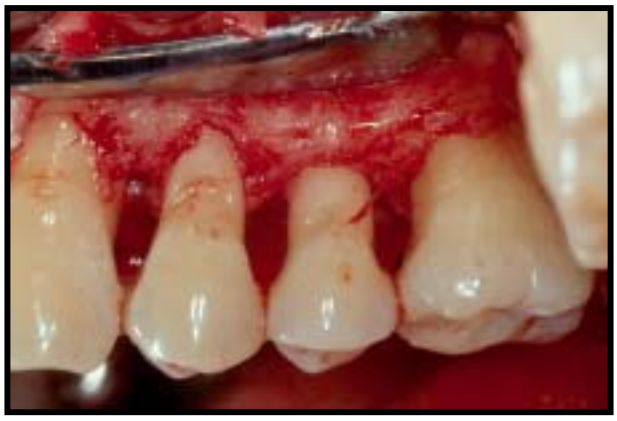

Figure 5-b.

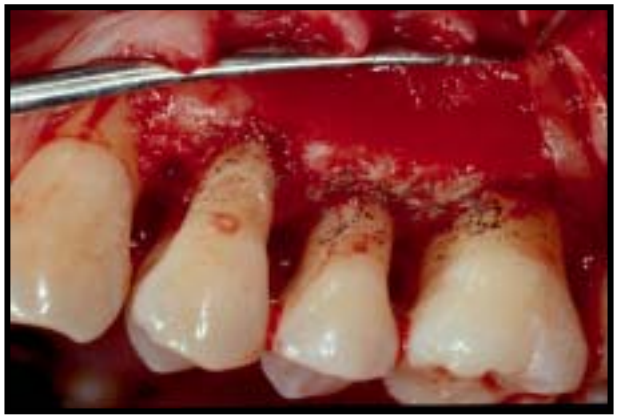

Figure 5-c.

Clinical photos (Ⅱ)

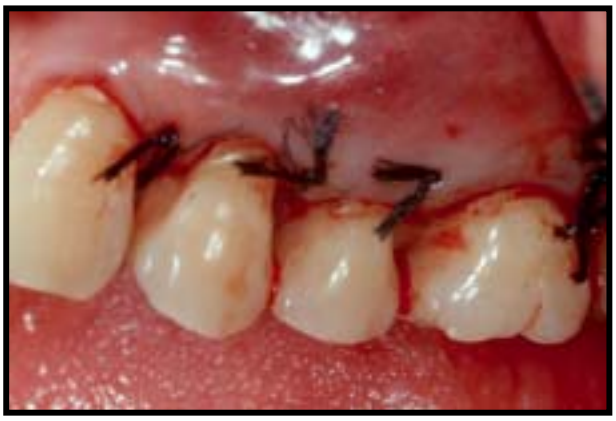

Figure 5-d.

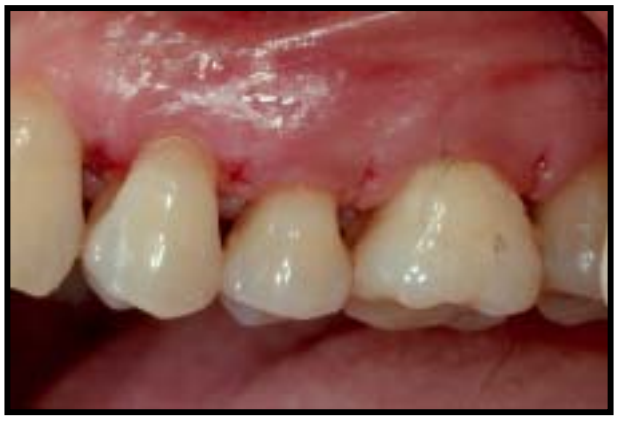

Figure 5-e.

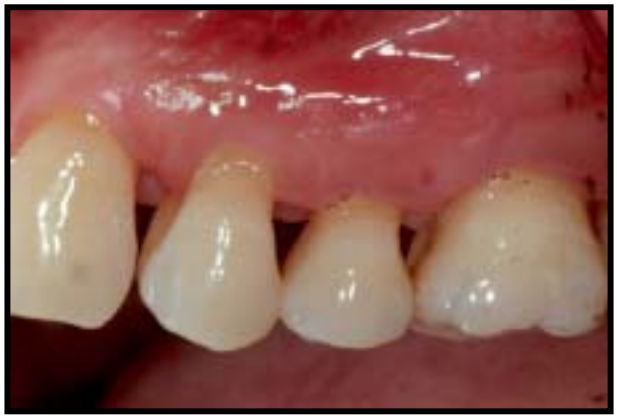

Figure 5-f.

국문 요약

치은 판막술에 CO_2 레이저를 부가적으로 사용했을 때의 IL-1β와 임상 지수의 변화

연세대학교 대학원 치의학과

(지도 김종관 교수)

최 경 희

치주 질환의 가장 중요한 원인인 치태와 치석의 제거는 치주 처치에 있어서 핵심이 되는 부분이다. 그러나 기계적인 방법만으로 이를 완전히 제거하는 것은 많은 시간이 소요될 뿐만 아니라 기술이 요구되며 일반적으로는 수행하기 어렵다. 이에 몇몇 연구자들은 부가적인 방법으로 레이저의 사용을 제안해왔다. 이 연구는 Y대학교 치과대학 부속병원 치주과를 내원한 성인성 치주염 환자 12명을 대상으로 하여 치은판막술시 치근면에 CO_2 레이저를 부가적으로 사용하였을 때 IL-1β level과 여러 임상지수를 측정함으로써 그 임상적인 효과를 평가하였다. 각 환자의 3악 중 치은 판막술만을 시행한 부위를 대조군, 치은 판막술과 0.5W로 레이저 치료를 시행한 부위를 실험군 1, 치은 판막술과 0.8W로 레이저 치료를 시행한 부위를 실험군 2로 설정하여 술후 2주, 4주, 6주에 GCF를 채취하고 3개월,

6개월에 출혈지수 빈도, 치주낭 깊이, 임상부착수준을 측정하여 다음과 같은 결론을 얻었다.

1. 출혈지수의 빈도는 술후 모든 군에서 감소하였다. 술전의 출혈지수의 빈도는 실험군 1, 실험군 2, 대조군에서 각각 80.2±19.9% 76.2±21.5%, 86.8±21.4%였으며 술 후 3개월시는 9.7±9.2%, 8.7±8.6%, 19.1±9.4%, 6개월시는 13.6±5.2%, 15.1±4.2%, 17.5±4.8%로 술전과 비교시 각 개월의 출혈지수의 빈도가 유의성 있게 감소하였다 ($p<0.05$). 각 군간 비교시에는 유의한 차이를 보이지 않았다 ($p>0.05$).

2. 치주낭 깊이도 모든 군에서 술후 3개월, 6개월에 감소를 보였다. 술전의 치주낭 깊이는 실험군 1, 실험군 2, 대조군에서 각각 5.0±0.6mm, 5.2±0.6mm, 4.8±0.5mm였고 술후 3개월에는 각각 2.5±0.3mm, 2.5±0.4mm, 2. 6±0.3mm로 약 2.3-2.6mm 가량의 치주낭 깊이 감소를 보였으며, 술후 6개월에는 2.6±0.3mm, 2.6±0.4mm, 2.8±0.3mm로 2.1-2.6mm 가량의 치주낭 감소를 보였다. 모든 군에서 술전과 비교시 유의성 있는 감소를 보였으며 ($p<0.05$), 군간에는 유의성 있는 차이를 보이지 않았다 ($p>0.05$).

3. 임상부착수준도 모든 군에서 술전과 비교시 술후 3개월, 6개월에 유의성 있는 감소를 보였다. 군 별로 비교해 보면 술후 3개월, 6개월시 실험군 1이

대조군에 비해 유의성 있는 부착 획득을 보였다 ($p<0.05$). 실험군 1과 실험군 2, 실험군 2와 대조군 간에는 유의성 있는 차이를 보이지 않았다 ($p>0.05$).

4. 술전 crevicular IL-1β는 실험군 1, 실험군 2, 대조군에서 각각 174.6± 34.2pg/ml, 136.1±54.1pg/ml, 188.5±92.7pg/ml였으나 술후 2주, 4주, 6주에 모든 군에서 유의성 있는 감소를 보였다 ($p<0.05$). 시간별로 각 군을 비교해 보면 술후 2주, 4주, 6주에서 모두 실험군 1과 대조군간에는 유의한 차이를 보였으나 ($p<0.05$) 실험군 1과 실험군 2, 실험군 2와 대조군 간에는 유의성 있는 차이를 보이지 않았다 ($p>0.05$).

이상의 결과에서 치은 판막술시 치근면에 0.8W로 CO_2 레이저를 부가적으로 사용하였을 때 IL-1β 감소, 부착 획득의 향상에 효과가 있는 것으로 사료된다.

핵심되는말 : CO_2 레이저, 성인성 치주염, Interleukin-1β(IL-1β), 치은 판막술, 임상부착수준