

Use of the CO₂ Laser on Orthodontic Patients Suffering from Gingival Hyperplasia

Sabrina K.C. Gama, D.D.S.

Centro de Ortodontia e Ortopedia Facial Prof. José Édimo Soares Martins, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Brazil.

Laser Center, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Brazil.

Telma Martins De Araújo, Ph.D.

Centro de Ortodontia e Ortopedia Facial Prof. José Édimo Soares Martins, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Brazil.

Daniel Humberto Pozza, Ph.D.

Laser Center, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Brazil.

Antonio Luiz B. Pinheiro, Ph.D.

Laser Center, School of Dentistry, Federal University of Bahia (UFBA), Salvador, Brazil.

Objective: The present study aimed to assess the effect of the use of the CO₂ laser on the treatment of gingival hyperplasia in orthodontic patients wearing fixed appliances. **Background Data:** Gingival hyperplasia is a condition very frequent in patients undergoing fixed orthodontic treatment. Amongst the treatments available for this is the use of surgical lasers. **Methods:** Ten patients entered this study and signed an informed consent. Seventy-five anterior teeth with gingival hyperplasia were selected for laser surgery. Prior to surgery, the length of the crowns were measured using a digital caliper, and depth of the pocket was probed. The hyperplastic gingival was removed with a CO₂ laser under local anesthesia. Immediately after surgery, measurement of the length of the crowns and probing were carried out and were repeated. **Results:** The results were statistically analyzed and significant differences were detected regarding the length of the crown ($p = 0.000$) and depth of the gingival sulcus ($p = 0.000$). **Conclusion:** It is concluded that the use of the CO₂ laser was effective in the treatment of gingival hyperplasia.

INTRODUCTION

PATIENTS undergoing orthodontic treatment with fixed appliances usually develop gingival hyperplasia.¹ Its development is usually attributed to chronic inflammation,² and may cause both esthetic and functional problems for the patient, including changes in tooth position³ for young adults.⁴ Some changes in the soft tissues are not very significant. However, the gingival margin may influence the final result of the orthodontic treatment, thus demanding special attention from orthodontists, periodontists, and oral surgeons.⁵ In many cases, the gingival hyperplasia demands periodontal surgery in order to increase the length of the crown during or after the orthodontic treatment.¹

The gingival margin is a rounded structure that forms a small invagination or sulcus between the tooth and the gingiva. After the eruption of the tooth, this margin ranges from 0.5 to 2

mm from the cement-enamel junction⁶ and depths above 3–4 mm represent a pseudo-pocket.⁷ Gingival hyperplasia may be treated by gingivectomy, followed by mechanic control of the dental plaque and improvement of the oral hygiene.¹ Lately, the use of the CO₂ laser for this procedure has been proposed.⁸ Among surgical lasers, the most commonly used on the oral cavity are the CO₂, Nd:YAG, and Ar lasers.^{9,10} Most recently, the Er:YAG laser has also been used for surgical procedures on the mouth.^{10,11} Depending upon the laser used, the biological response may be different. When the CO₂ laser is used, the thermal effect is mostly predominant,¹¹ and the laser light is well tolerated by the oral tissues.¹² The use of the CO₂ laser on orthodontic patients aims for the achievement of better contour and shape of the gingiva, as well as for increasing the length of the crown and correct gingival asymmetry.¹¹ Procedures and benefits of CO₂ laser surgery have been reported elsewhere in the literature.

^{11,13–16} One advantage of the use of the CO₂ laser in the treatment of gingival hyperplasia is less bleeding and pain, and an easier post-operative period, which makes large-scale procedures possible on the mouth in a single surgical session, including procedures on children.^{10,15,17,18} Much less wound contraction and scarring are also advantages of this technique, and this is attributed to the small number of myofibroblasts on CO₂ laser wounds.^{8,19–23}

Despite several reports on the effects of CO₂ surgery on soft tissues, none have used numeric parameters to assess the results of the procedure.^{8,10,12,13,18,19,24–30} The present study aimed to assess, numerically and statistically, the effect of the use of the CO₂ laser on the treatment of gingival hyperplasia in orthodontic patients wearing fixed appliances.

METHODS

Ten patients suffering from gingival hyperplasia on either upper and/or lower anterior teeth and wearing the Edgewise Standard appliance were selected (at the Centro de Ortodontia e Ortopedia Facial Prof. José Édimo Soares Martins, FOUFBA) and agreed to enter this study; they all signed an informed consent according to Brazilian regulations. Patients using medications or with impaired motor activity were excluded. Seventyfive areas (teeth) of gingival hyperplasia were selected on these patients. Before surgery, the patients underwent routine laboratory and imaging examinations. Prior to surgery, the patients had the appliance removed and professional prophylaxis was performed (Profident, Dabi Atlante®). Probing of the sulcus was performed with a calibrated periodontal probe (SS White Duflex).

Probing was carried out on three sites at the buccal surface of each tooth prior to (Fig. 1a–c) and immediately after the surgery (Fig. 1d–f), and values were recorded. Depths above 3 mm characterized a pseudo-pocket and indicated surgery.⁷



FIG. 1. Probing of the gingival sulcus was performed prior to (a–d) and immediately after (e,f) surgery.

The length of the crowns was also measured using a calibrated digital caliper at the same times (Fig. 2).



FIG. 2. Measurement of the crown length was performed prior to (a,b) and immediately after (c,d) surgery.

The surgical procedure was carried out at the Laser Center of the School of Dentistry of the Federal University of Bahia by an experienced oral surgeon. The laser used was a CO₂ laser (Sharplan 20C, Tel Aviv, Israel; _ 10.600 nm, 5 W, _ 0.2 mm, RSP/CW). All procedures were carried out under local

anesthesia. An individual diagram was drawn by the orthodontist in order to make the procedure more precise (Fig. 3).

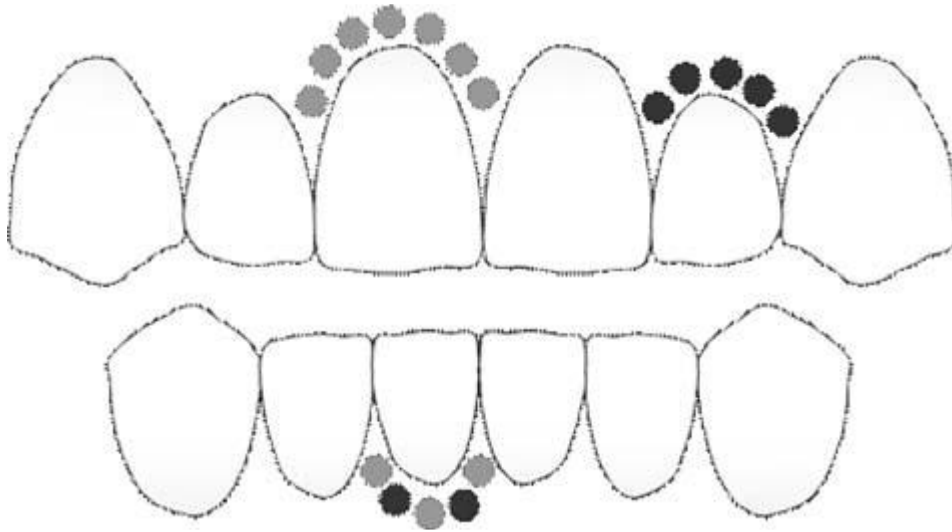


FIG. 3. Template used to determine the areas for the removal of the gingival.

The surgical procedure consisted of vaporization of the hyperplastic gingival using the laser defocused. Gingivoplasty was carried out at the end of the procedure. Extra care was taken in order to prevent undesired lasing of the hard tissues. Neither suturing nor dressing was used after surgery. An analgesic was prescribed in case of pain, and a standardized oral hygiene protocol was described for use during the following 15 days. Diet recommendations were also given to the patients. Measurement of the length of the crown and probing were repeated immediately after surgery, and after 1 and 2 months. Immediately after the measurement and photography, the appliances were placed back.

Statistical analysis

The results were stored and statistically analyzed by Student *t*-test, analysis of variance (ANOVA), and Tukey test at 5% confidence level.

RESULTS

Seventy-five teeth were used for this study. Measurements were taken at four times points: preoperative (T0); immediately after surgery (T1), 1 month after surgery (T2), and 2 months after surgery (T3). On T3 there was a loss of 18.67% of the sample, and 61 out of 75 units were assessed. The results were tested and considered normally distributed by the Kolmogorov-Smirnov test. The means and standard deviations can be seen on Table 1.

TABLE 1. CROWN LENGTH THROUGH THE EXPERIMENTAL PERIOD

	<i>Time</i>	<i>Mean ± SD</i>
Crown length	0	7.41 ± 1.22
	1	8.19 ± 1.19
	2	8.33 ± 1.22
	3	8.57 ± 1.13

Figure 4 shows the variation on the length of the crown during the experimental period. Significant increase on the length of the crown following the surgery was observed from time 0 to 1 (ANOVA, $p = 0.000$). There were no significant changes up to the end of the experimental period. The measurements of on the mesio- and disto-buccal areas were found to be similar during the experimental time and were grouped for the analysis (Fig. 5). A significant reduction was observed on the depth of the gingival sulcus following the surgery (ANOVA, $p = 0.000$). Measurement of the central area of the buccal surface also showed significant reduction on the depth of the gingival sulcus (ANOVA, $p = 0.000$) when compared to time 0. No further differences were observed up to the end of the experimental period (Fig. 6).

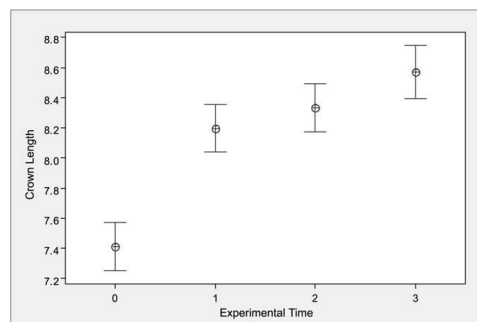


FIG. 4. Mean of the crown length measurements during the experimental time.

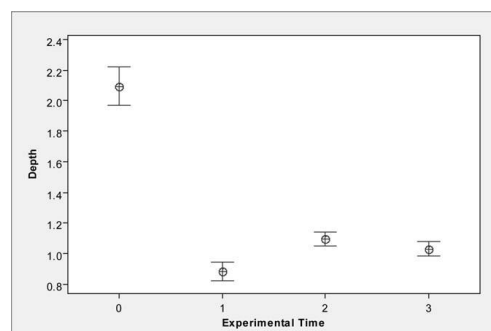


FIG. 5. Mean of the depth of the gingival sulcus on the mesio- and distobuccal areas.

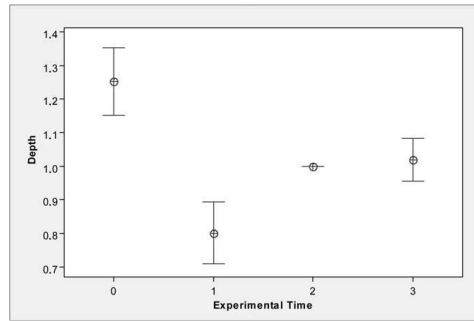


FIG. 6. Mean of the depth of the gingival sulcus on the central buccal area.

DISCUSSION

Clinicians providing cosmetic dental services must stay current techniques available for soft tissue contouring. Only recently has periodontal plastic surgery been presented at dental meetings, and little information exists in the research literature. Surgical lasers contribute significantly to the field of cosmetic dentistry, providing an invaluable resource for clinicians who perform different types of esthetic procedures. Practitioners in this specialized field not only help patients acquire beautiful and ideal smiles and dental health, but also assist patients in benefiting from tremendous clinical advantages, such as sterile surgical sites and increased comfort levels. Esthetics and function are major factors responsible for the patient's choice to undergo orthodontic treatment. Despite rigorous control by the orthodontist, some complications may occur during the treatment, and gingival hyperplasia is one of the most frequent problems affecting patients under orthodontic treatment. Reports on the use of the CO₂ laser on procedures on the oral cavity can be found elsewhere in the literature. Most of the studies have shown that CO₂ laser surgery is capable of improving the results of many types of procedures. Due to the particular characteristics of the mouth, the preservation of both function and esthetics is extremely important for the patients. A gingivectomy performed with a CO₂ laser is a short, easy procedure that produces an immediately dramatic effect. Compared to a scalpel gingivectomy, there is excellent hemostasis, which improves visualization, requires less need for periodontal packing, and results in minimal postoperative discomfort. 27

Despite a previous report¹¹ suggesting that the CO₂ laser results in increased crown length after surgery, these results were not statistically assessed. The increase on the length of the crown as a result of CO₂ laser was confirmed by the present study as a significant increase on the size of the crown from time 0 to time 1 was found. This aspect is very important to be considered as conventional surgical procedures carried out by scalpel or electrical surgical devices results on contraction of the healing tissue. This may result in impairment of function, on the formation of scars and compromised esthetics. As no further significant increase on the length was seen afterwards on the present study, it is confirmed that CO₂ laser surgery does not result on significant wound contraction during the healing time as previously reported^{9,19,20,23} being this assessed on three different areas of the crown. It was evident the significant reduction of depth the gingival sulcus immediately after surgery. From day 30, a non-significant increase on the depth was seen, and this was probably due to the return of the normal physiologic status of the marginal gingiva. Immediately after surgery, it was very difficult to measure the

depth of the sulcus as the surgical procedure leaved the sulcus very shallow. Later, the gingiva came back to its normal function and the physiologic depth of the sulcus was restored and, most importantly, it was maintained during the experimental time. The results of the CO₂ laser surgery regarding the crown length and gingival sulcus depth remained without significant changes up to 60 days. Being the same observed also when the surgery was also carried out to reduce the thickness of the gingiva. No gingival overgrowth was seen during the experimental time.

In no case was suturing or any type of dressing used, and other than odor during the surgical procedure, there were no complaints from the patients undergoing CO₂ laser surgery. The post-operative period was "silent." A previous report noted that most complications associated with laser surgery occur in the post-operative period.²⁸ These complications are mainly related to the healing and infection. Infection would then play an important role on a delayed wound healing. Poor wound healing may lead to unaesthetic scarring. Some degree of pain is also expected following laser surgery. In the present study, no complications occurred, and this was due to careful pre-operative care, to the use of appropriate surgical technique, and to a controlled post-operative period.^{8,10,12,13,18,19,24–30}

Despite the large number of publications, there is still controversy among clinicians regarding the application of dental lasers to the treatment of periodontal conditions. There is a considerable conflict in results for both laboratory studies and clinical trials, even when using the same laser wavelength. A meaningful comparison between various clinical studies or between laser and conventional therapy is difficult at best and likely impossible at the present. Reasons for this dilemma are several, such as different laser wavelengths; wide variations in laser parameters; insufficient reporting of parameters that, in turn, does not allow calculation of energy density; differences in experimental design, lack of proper controls, and differences in severity of disease and treatment protocols; and measurement of different clinical endpoints.

It is concluded that the use of the CO₂ laser for the removal of gingival hyperplasia on orthodontic patients is long-term and efficacious in terms of increasing crown length and reducing the depth of the gingival sulcus.

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