Minimal invasive method to treat hemangiomas of the oral cavity with CO_2 laser.

Ester M. D. Nicola, Jorge H. Nicola, Reinaldo J. Gusmão, Adriana A. Coutinho and Nilceu Cassitas

EMDN, RJG, NC, AAC, Medical School, JHN, Institute of Physics
Univ. Estadual de Campinas - UNICAMP, Campinas, SP, Brazil.

ABSTRACT

During the last six years we have developed a new CO_2 laser technique for the treatment of symptomatic oral cavity hemangioma. Our new technique, named "Laser encircling technique", has especially succeeded during hemangioma buccal maxillary surgeries. The treatment consisted in the application of a line of points of CO_2 laser circling the lesion. Depending on the position and size of the lesion, we used from 0.4 to 4.0 Joules/mm^2 laser energy density per pulse, causing reduction in the size of the lesion throughout the sclerosis of nutritional vessels which led to reduction in size, volume and color of the hemangiomas with no significant bleeding or inflammatory reaction.

In this work forty male and female patients, twelve to fifty years old, presenting medium to small size hemangiomas situated in different sites of the oral cavity such as the tongue, mouth vestibule, pharynx, tonsil area and lips were treated by the procedure described above. The number of laser applications was defined by the peculiarities of each case, varying from 3 to 6 sessions at 4 week intervals, always under local or topic anesthesia.

The patients complained about minimal post operative discomfort and had good cicatrix evolution. The good results achieved by this technique lead to the conclusion that CO_2 laser for these types of hemangioma is an efficient and very secure method of treatment.

An important aspect of our technique is the fact that using relatively low laser power we do not perform real surgery but a less aggressive alternative of treatment.

Keywords: laser encircling; hemangioma; CO_2 laser; oral cavity; soft tissue

2. INTRODUCTION

Hemangiomas are very common benignant tumors, the greater part of which originate congenitally, and they constitute around 7% of all benign tumors. They are composed of the aggregation or proliferation of blood vessels, and morphologically they can be classified as either capillary and cavernous. They occur most frequently in first and second childhood[1,2].

Capillary hemangiomas are made up of vascular structures which are normally of small caliber, separated by scarce conjunctive tissue and tightly wrapped around each other. Generally, they are small lesions, a little elevated or merely flat with coloration that can vary from red to blue. They appear well delineated, although they are not encapsulated. Histologically, they are characterized as an aggregation of capillaries with very thin walls separated by scarce conjunctive tissue. In general they appear in the skin, subcutaneous tissue, oral mucous, the lips, but they can occur in any organ or tissue[1].

Cavernous hemangiomas usually present spongy masses of soft consistency and of red to blue color with average diameters of 1 to 2 cm. This aspect can, however, become altered because of intravascular thrombosis and/or ruptures of the vascular channels, assuming a hard texture or even creating ulcerated areas, all of which predisposes bleeding. Sometimes gigantic forms can occur involving large areas of the face, extremities and, more rarely, other parts of the body. Histopathologically, they appear as well limited, nonencapsulated lesions, consisting of ample cavernous vascular spaces which are totally or partially filled with blood and separated by scarce conjunctive tissue[1].

The great majority of hemangioma lesions occur in the region of the head and neck, being that 85% spontaneously regress by the end of the fifth year of age. In some situations lesions do not totally regress, but they remain symptomatic because of their small dimension or locality and therefore, do not require any type of treatment[2,3,4].

The conduct of hemangiomas can be expectant (until 5 years old) as well as clinical (scleroses, corticoids) or surgical. In the case of surgical conduct, this can be performed by using electrocoagulation, cryosurgery, conventional surgical excision or laser[3,5].

Lasers more commonly utilized in treating hemangioma lesions are the Argon - KTP and, more recently, the copper vapor laser, since the frequency they emit (color) presents great interaction with the pigment (Oxi-hemoglobin) abundant in these lesions[6,7]. The Nd-YAG lasers are also widely used in vascular lesions because of the excellent absorption of the frequency they emit by vascular tissue, leading to effective large blood vessels coagulation deeply located in the lesion. This makes Nd-YAG laser more suitable to be used in bulk Hemangiomas[3,5,8]. The CO_2 laser, because of its far infrared radiation (10.6 micrometers), presents an entirely thermal effect without any selectivity for different pigments. Therefore its effect upon the tissue is in the first place one of cutting and/or tissue vaporization, with predominant effect starting in tissue surface. Therefore, a thorough understanding of the physical parameters of this equipment can permit its utilization in surgical removal of hemangiomas, actuating in areas of tissue that are peripheral to the lesion as well as in more conservative approaches[2,9,10,11,12,13].

The majority of lesions in the oral cavity occur in soft tissue, principally the lip mucosa, tongue, jugal mucosa, gums and palate. The lesions appear in diverse shapes and sizes which are sometimes global and pedicle and other times flat with wide bases. They have a soft consistency, wine coloring and regular contours[2,3].

Symptomology varies considerably depending on the size, type and location of the lesion. Bleeding and discomfort which make chewing, deglutition, phonation and hygiene of the oral cavity difficult, can be observed. Non syntomatic lesions can also be find, which may not require any type of treatment[2,5].

In the conventional surgical approach, which can also be performed with CO_2 laser, the lesion is removed in its totality. Part of the adjacent integral tissue is also removed in order to permit greater safety in the procedure and adequate homeostasis of the surgical wound[9]. When the lesion is medium size (3 cm x 2 cm) or smaller, the conventional surgical process with laser already produces the additional benefit of frequently not requiring suture, which reduces undesirable fibroses and scars[9,13].

Some lesions present almost insuperable difficulties for conventional total surgical resection, even using the laser. Relatively small lesions located in an area subject to safe surgical removal can produce esthetic limitations which discourage total conventional surgery. Examples of these cases are Hemangiomas of labial commissure and of the transition area of skin-mucosa of the lips. In other cases surgical limitation is due to the great extension of the lesions which require ample resection, resulting in deformities and important functional alterations. Furthermore, the location of Hemangiomas in an area difficult for surgery, like that close to large

caliber blood vessels as in the case of Hemangiomas in the tonsil chamber and in the region behind the tongue, represent an additional difficulty for total surgical resection[12].

The new technique which is presented here has permitted intervention in these types of hemangiomas principally because of its treatment aspect and not especially its surgical property. Thus, resection of lesions is not done with a conventional process but rather with micro cauterizations of CO_2 laser in locations, depths and quantities defined by the peculiarities of each lesion. This procedure, which is able to diminish symptomology, is accepted as safe by the patient and the surgeon.

3. MATERIAL AND METHOD

In the present study 40 patients who had been sent from the Otorhinolaryngology Clinic of the General Hospital of the State University of Campinas (UNICAMP) for treatment at the Medical Laser Unit of the Hospital were accompanied for 6 years. They were of both sexes between 12 and 50 years old, suffering from symptomatic Hemangiomas of the oral cavity which could not be totally removed surgically because of the reasons mentioned above. The procedures were performed under local anesthesia by using a CO_2 Laser with 30W of power coupled to an articulated arm and handpiece or to a surgical microscope, depending on the location of the lesion.

All the patients who seek our services frequently present the following complaints: bleeding (consequent to traumas during eating and hygiene), pain, infections, discomfort and difficult pronunciation.

The treatment consisted of the application of the CO_2 laser according to the technique we developed and which we call "encircling". During encircling technique an almost continual line of pointed perforations (fig. 1) is produced by CO_2 laser pulses of 2.0 to 5.0 joules/mm^2 with the majority of the pulses at an energy density of 4.0 joules/mm^2.

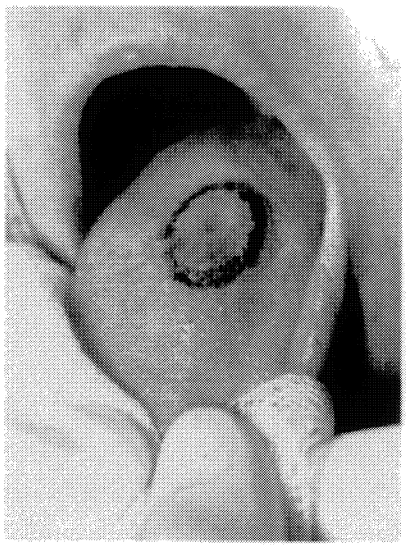


Fig. 1 - Encircling technique applied to Tongue Hemangioma, 4 J/mm^2 energy density.

In these situations superficial perforations were obtained, reaching peripheral vessels only by direct action of the laser pulse as well as indirectly by heat diffusion since the line of points encircling the lesion was repeated three times each session, elevating the local temperature.

Following this, laser points with 0.4 to 1.2 J/mm^2 were produced over the whole surface of the lesion, superficially reaching it without provoking perforations and only actuating by means of thermal diffusion and thus avoiding difficult to contain bleeding. Choice of parameters was determined by the size of the lesion as well as tissue thickness.

Both techniques were applied in various sessions with four week intervals. The average number of sessions was from 3 to 6 according to the size of the lesion.

Power Density (watts/mm^2)	Time (segundos)	Energy Density Joules/mm^2
10.0	0.2	2.0
6.0	0.5	3.0
8.0	**0.5**	**4.0**
10.0	0.5	5.0

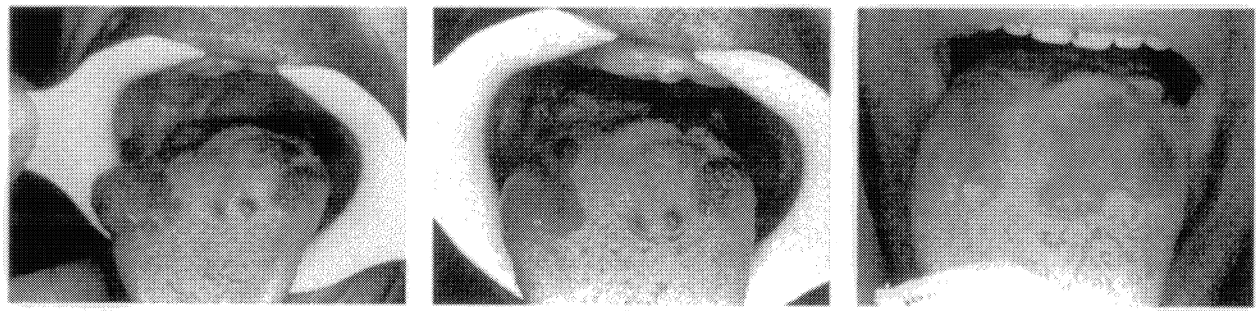
Table 1 - Energy densities used in encircling technique, emphasizing the most used situation (4.0 joules/ mm^2).

Power Density (watts/mm^2)	Time (segundos)	Energy Density Joules/mm^2
6.0	0.050	0.30
4.0	0.100	0.40
6.0	0.100	0.60
4.0	0.200	0.80
6.0	0.200	1.20

Table 2 - Energy densities used for making laser points over the whole extension of lesion.

a b c

Fig. 2 - Tongue Hemangioma: before treatment (a); after the second application (b); 6 months after the last laser session (c).



a b c

Fig. 3 - Multiple Hemangiomas on dorsal surface of tongue: before treatment (a); two months after the first laser session (b); twelve months after beginning applications, patient still under treatment (c).

4. RESULTS AND DISCUSSION

During this procedure, even in the first sessions, rarely there was verification of bleeding that needs to be contained by suturing. In general, simply defocusing the laser was sufficient to obtain homeostasis.

Average and large lesions (3.0 x 4.0 cm^2) already presented evidence of involution in volume as well as in coloration after the second laser application; however, small lesions, even those with cavernous aspects, presented much greater involution after the first application (fig. 2a,b,c).

The patients did not complain of significant discomfort or other occurrences during and after the operations, and antinflammatories and/or analgesics were only rarely used[12].

In all cases cicatrix evolution was excellent with significant regression and even disappearance of the lesions according to routine photographic documentation of each laser session and 3, 6 and 12 months after ending treatment.

The CO_2 laser appears to be the preferred instrument for obtaining the results desired in these cases. Being infrared, this radiation is integrally absorbed by any live tissue, making it possible to produce extremely

local heat with its consequent vaporization, cauterization and denaturation of tissue as shown in fig. 4 in the photograph of a cross section of tissue perforated by a CO_2 laser pulse.

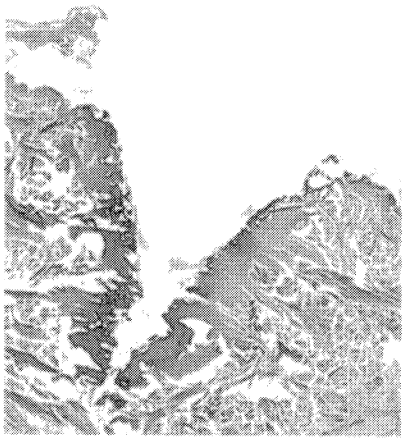


Fig. 4 - Cross section of tissue showing profile of perforation produced by a CO_2 laser.

In this way, small caliber vessels (up to 0..5 mm in diameter) which are encountered in the trajectory of the laser pulse are totally vaporized and sealed. Other vessels, peripheral to the perforation point, will suffer heat diffusion action and also be affected, principally because this is a repetitive procedure[9,13].

In an experimental work performed in the Laser Laboratory of the NMCE at the School of Medicine of UNICAMP, the oral mucosa of dogs as well as the skin and muscle of rats on various occasions showed evidence of the effects referred to above in the histological slices.

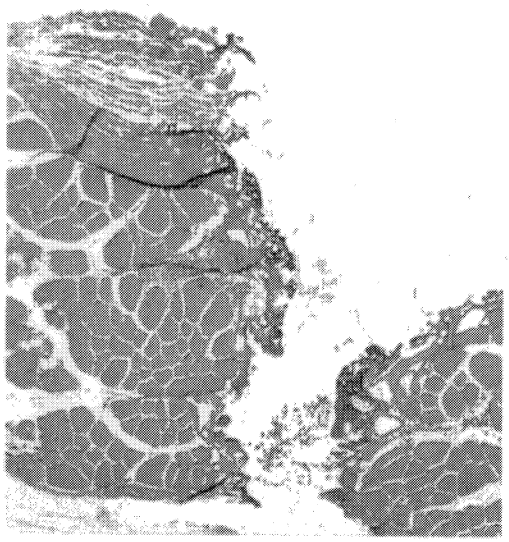


Fig. 5 - Histological slice showing a laser perforation with a large content of blood cells resulting from damaged vessels.

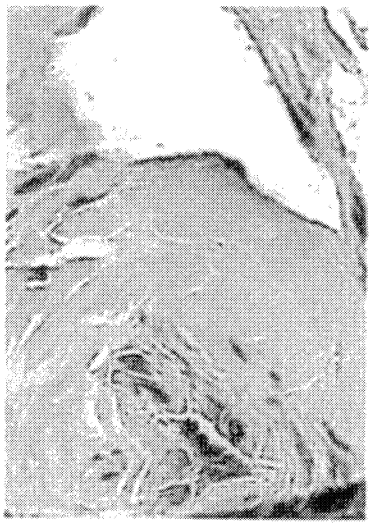


Fig. 6 - Blood vessel at the bottom of a laser perforation. Observe the necrosis surrounding the vessel.

The fact that the pulse is relatively rapid, well focused and with adequate power provides an effect restricted to the region of application, impeding bleeding even though the Hemangiomas are well irrigated. Each region of the Hemangioma close to the line of perforations provoked by the laser represents a zone of partial interruption of the irrigation of the lesion, leading to the results demonstrated in the present work.

In the present work, the perforations on the periphery (encircling) of the Hemangiomas were complemented by superficial thermal action of the laser over the full extension of the lesion. Certainly, the mechanism of the action on the surface was similar to that described above, restricted, clearly, to the thermal effect.

Other types of lasers can be used in this same methodology; however, the parameters of energy density should be appropriate to the specific type of laser to be used in function of the degree of radiation absorption of the same by the Hemangioma.

5. CONCLUSION

Infrared radiation of the CO_2 laser is recognized as nonselective with regard to its action on pigmented or non pigmented tissues; as such, its indication for the treatment of pigmented lesions like Hemangiomas is generally considered as a more radical surgical technique. In the present work we showed that the CO_2 laser when utilized according to our technique presented results that, up to the present moment, are not obtained by any other technique.

The procedure used determines sclerosis of vessels with consequent fibrosis of the hemangioma and the diminution of extension and vascularization of the lesion leading to the total disappearance in the majority of cases.

Esthetic and functional results appeared to be highly satisfactory and even absolute, regarding the disappearance of initial symptomology.

We can therefore conclude that the technique proposed in the present study appeared to be a safe and efficacious method in the treatment of symptomatic hemangioma with excellent results regarding the complaints of the patient as well as the expectations of the surgeon.

6. ACKNOWLEDGMENTS

The authors thank to Dr. Konradin Metze, from Medical School - UNICAMP, for his help with the Histological procedures used in this work. This work was partially supported by FAPESP - Fundação de Amparo à Pesquisa do Estado de São Paulo, Brazil.

7. REFERENCES

1. S. L. Robbins, R. S. Cotran and V. Kumar, Patologia estrutural e Funciona, p. 521,Editora Guanabara, Rio de Janeiro, RJ, Brazil (in Portugese), 1991.
2. D. M. Crockett, T. J. I. McGill, G. B. Healy and E. M. Friedman, "Benign Lesions of the Nose Cavity, and Oropharynx in Children: Excision by Carbon Dioxide Laser" Ann Otol Rhinol Laringol, 94, pp. 489 - 493, 1985.
3. L. M. David and S. Zeitels, " Neodymium - YAG Laser Photocoagulation of Hemangiomas of the Head and Neck", Laryngoscope, 97, pp.323 - 330, 1987.
4. D. B. Hawkins, D. M. Crockett, E. J. Kahlstrom and E. F. MacLaughlin, " Corticosteroid Management of Airway Hemanfiomas: long term follow-up", Laryngoscope, 94, 00. 633 - 637, 1984.

5. J. Y. Suen and M. Waner, " Treatment of Oral Cavity Vascular Malformations Using the Neodymiom- YAG Laser", Arch Otolaryngol Head Neck Surg, 115, pp. 1329 - 1333, 1989.
6. T. A. Abd-El-Raheem, U. Hohenleutner, O. Braun-Falco and M. Landthaler, "eruptive Satellite Angiomas of the Oral Mucosa", Acta Derm Venereol, 74, pp. 72 - 76, 1994.
7. H. Lenz and J. Eichler, " The Effect of the Argon Laser on Vessels, the Macro and Microcirculation of the Mucosa of the Hamster Cheek-Pouch. An Intravitalmicroscopic study", Laryngol- Rhinol-Otol-Stuttg., 54(7), pp. 612 - 619, 1975.
8. D. B. Apfelberg, "Intralesional Laser Photocoagulation-Steroids as an Adjunct to Surgery for Massive Hemangiomas and Vascular Malformations", Ann-Plast-Surg, 35(2),pp. 144 - 148, 1995.
9. D. B. Apfelberg, M. R. Maser, H. Lash and D. N. White, "Benefits of the Co_2 Laser in Oral Hemangioma Excision", Plastic and Reconstructive Surgery, 75(1), pp.46 - 50, 1985.
10. I. Kaplan, R. Ger and U. Sharon, " The Carbon Dioxide Laser in Plastic Surgery" Br. J. Plast. Surg., 26, p. 359, 1973.
11. T. Ohshiro, "The Co2 Laser in the Treatment of Cavernous Hemangioma of the Lower Lip: a case report.", Lasers-Surg-Med., 1(4), pp. 337 - 345, 1981.
12. E. M. D. Nicola, A. A. Coutinho, J. H. Nicola and R. J. Gusmão, " Symptomatic Hemangioma of Oral Cavity Treated with CO_2 Laser", Proceedings of SPIE'95, VOL. 2395, pp. 189 - 195, 1995.
13. A. Actis, H. Juri and H. Gendelman, "Oral Hemangiomas Treated with Nd:YAG and CO_2 Laser", Journal of Clinical Laser Medicine & Surgery, 11(2), pp. 91 - 94, 1993.