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Treatment of Hemangioma of the Head and Neck with Diode Laser and Forced Dehydration with Induced Photocoagulation

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ABSTRACT

***Objective:* The aim of this study was to investigate the efficacy of treating oral hemangiomas using forced dehydration with induced photocoagulation (FDIP) via diode laser. *Methods:* One-hundred sixty patients were treated between 1999 and 2006 (76 men, 46%; 84 women, 54%). In 136 cases we used FDIP to treat hemangioma, and in 24 cases complete surgical excision was performed. One-hundred thirty-four lesions had a surface area $<2 \times 2$ cm^2, whereas only two had large lesions measuring 2.5×2 cm^2. *Results:* In 136 patients with hemangiomas treated with FDIP, 134 cases (98.53%) showed complete remission, one case (0.735%) did not show complete remission, and one case (0.735%) displayed tumor growth. There were no adverse effects and all patients were carefully followed-up until complete healing was documented, along with any complications. *Conclusions:* Our findings suggest that FDIP is a useful and effective treatment for benign oral vascular lesions. FDIP treatment of these oral lesions is clinically significant because it provides effective management, avoids recurrence, and shortens healing time. We believe that the use of this method by medical and dental specialists should be supported.**

INTRODUCTION

Benign vascular lesions are relatively common in the head and neck,[1–3] but their classification and nomenclature are divergent. In 1996, the International Society for the Study of Vascular Anomalies approved a classification system modified from Mulliken and Glowacki.[4] Vascular diseases were subdivided into (1) tumors, which includes hemangioma, pyogenic granuloma, rapidly involuting congenital hemangioma, noninvoluting congenital hemangioma, hemangiopericytoma, tufted angioma, and kaposiform hemangioendothelioma; and (2) vascular malformations.[5]

Clinically, the hemangioma is a red macula, mass, or swelling that develops during late fetal stages or in infancy, grows quickly, and generally undergoes spontaneous regression. Hemangioma has three different phases: proliferating, involution, and involuted. The proliferating phase (0–1 year of age) corresponds to increased activity and proliferation of endothelial cells with organization of masses, in some cases showing vascular lumens. The involution phase (1–7 years of age) is characterized by an initial maturation of blood vessels with dilatation of the vascular lumen and decreased cellular activity. The involuted phase is a final maturation of the lesion with a few tiny capillary-like feeding vessels and draining veins lined with flat mature endothelium.[5,6]

There are various treatments for hemangiomas. Surgery has been the main form of treatment for these lesions, although sometimes total removal is not possible because of the extent of the lesion, which may involve vital structures. Other possibilities include embolization, steroid therapy, cryosurgery, electrodesiccation, and laser therapy, which was introduced in 1960.[7–14] With the introduction of laser therapy, a new alternative emerged. The 810–830 nm diode laser beam is poorly absorbed by water and selectively absorbed by hemoglobin. Due to its poor absorption by water, the laser penetrates deeply into the tissue, down to a depth of 4–5 mm. As it passes through the tissues, the laser beam generates heat and thus coagulates tissue down to a depth of about 7–10 mm, a process called pho-

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tocoagulation. Its selective absorption by hemoglobin and the heat generated by the continuous wave mode cause selective photocoagulation within blood vessels. The diode laser energy is delivered by a flexible optic fiber, which makes it easy to handle; forced dehydration with induced photocoagulation (FDIP) is a non-contact technique. Irradiation is delivered by means of a flexible quartz fiber that is kept 2–3 mm from the lesion at an energy output of 2.5–6 W in continuous wave mode for a 5–10 sec exposure. The fiber tip should not be held in the same place for too long, but should be moved slowly over the lesion, while observing tissue shrinkage and blanching. Before and during laser therapy, the surface is cooled with cold physiological solution to protect the superficial tissues from damage. Photocoagulation must be performed with a safety margin that extends slightly beyond the visible extent of the lesion. In this way tissue sloughing, which could lead to hemorrhage,[9] does not occur within the hypervascularized area.

We used this type of laser in this study to exploit its properties, that make it ideal for this type of procedure. The study addresses three issues: (1) to assess the precision of treatment of oral hemangiomas and lymphangiomas; (2) to evaluate recurrence of the lesions; and (3) to ascertain if healing of oral hemangiomas is improved.

METHODS

Laser surgical procedure

From 1999 to 2006, 136 patients were treated for vascular lesions with FDIP, and 24 were treated surgically. One characteristic of FDIP is that is a non-contact technique and thus it is noninvasive. Irradiation was delivered by means of a flexible quartz fiber that was kept 2–3 mm away from the lesion, at an energy output of 2.5–6 W with a mean value of 4.1 W, in continuous wave mode for 5–10 sec with a mean fluency of 20 J/cm^2. The endpoint of treatment was blanching and visible shrinkage of the lesion. Before and during laser therapy, the surface was cooled with physiological solution to protect the superficial tissues from damage. Treatment was performed without topical, local, or general anesthesia. All vascular lesions were documented photographically at all stages of treatment and healing (Figs. 1 through 9). The power settings used were the lowest that produced a therapeutic effect. In patients with large lesions, one session was usually not enough, and one or two subsequent "touch-up" sessions were necessary.

FIG. 1. Photograph of multiple congenital lip hemangiomas in a 42-year-old woman.

FIG. 2. The patient was treated with an 810-nm diode laser in CW mode at 4.0 W power.

Patient data

Clinical evaluation was comprised of a retrospective review of patient records. There was a total of 160 patients, 76 men (46%) and 84 women (54%), aged 15–70 years with a mean age of 20 years, with vascular mucosal and cutaneous lesions. Of the 160 total patients, 136 were treated using FDIP with a diode laser, and 24 were treated surgically. All patients suffered from hemangiomas, and in most cases the diagnosis was made on the basis of clinical presentation; in some atypical cases, Doppler ultrasonography, diagnostic histopathology, angiography, and computed tomography were necessary to confirm the diagnosis. All lesions were located in the head and neck. Of these, 33 were located on the tongue, 27 were on the cheeks, 56 were on the lips, 7 were on the palate, 3 were on the floor of the mouth, and 10 were on the gingiva. Indications for laser treatment were rapid uncontrollable growth, or lesions affecting functional areas or producing cosmetic defects.

Patients with small lesions ($<2 \times 2$ cm^2) were treated in one session, whereas those with lesions up to 2.5×2 cm^2 in size were treated in two sessions. Patients were monitored weekly until healing was complete. After treatment, patients were not given analgesics, but in some cases mouthwash was prescribed to improve oral hygiene.

RESULTS

Of 136 cases, 134 patients (98.53%) received one treatment, and two patients (1.47%) received two treatments. In 136 patients with hemangiomas, 134 cases (98.53%) showed complete remission, one case (0.735%) had partial regression, and one case (0.735%) displayed tumor growth.

Immediately after laser treatment, all patients developed slight swelling of the treated area that lasted a few days. Postoperative pain was minimal in most patients. None of the typ-

FIG. 3. After 3 wk the lip has complete healed.

ical adverse effects (scars, hyper- or hypopigmentation, atrophy, or wrinkled texture) were seen after complete regression had occurred. The patients were followed-up for a maximum of 8 years (mean 6 years).

DISCUSSION

Various therapeutic modalities are available for benign vascular disease, depending on their type and location, as well as the depth and progression of the lesion. Often they do not need any treatment; other types may be associated with serious sequelae, such as extensive growth, bleeding, or obstruction, and thus require immediate intervention.[10–15]

Therapeutic options include observation, since hemangiomas invariably involute and can therefore sometimes be left untreated (watchful waiting).[15] Observation is recommended for malformations that are small or superficial, although there is still controversy regarding the need for treatment. Cryosurgery is useful for the early treatment of small, superficial hemangiomas, though there is a risk of hypopigmentation, atrophy,

FIG. 5. The patient was treated with an 830-nm diode laser at 3.5 W power.

and scarring of the skin.[16] Embolization can be used in conjunction with other approaches; corticosteroids are indicated for massive and rapidly-growing vascular tumors, at a dose of 2–4 mg/kg/d of prednisone or prednisolone, with gradual tapering of the dose.[17] Bennett et al. reported a response rate of 84% to steroid therapy.[18] However, side effects, including growth retardation, cataracts, infections, and cushingoid characteristics, mitigate against this modality. Interferon alfa-2a, an inhibitor of angiogenesis, is reserved for life-endangering or life-threatening corticosteroid-resistant hemangiomas, because it may produce an elevation of liver enzymes, neutropenia, and even neurological side effects (spastic diplegia).[19] Surgery is also frequently used, particularly if the hemangioma has failed to respond to other measures, or when residual lesions remain.[20,21]

Since its introduction into medicine in 1960, several types of lasers, including 514 nm argon, 532 nm KTP, 585 nm FPDL (dye laser), 600 nm LPTDL, 755 nm alexandrite, 810–940 nm diode, 1064 nm Nd:YAG, p-Nd YAG, and 10600 nm CO_2 lasers

FIG. 4. Hemangiomas of the left cheek in a 43-year-old woman.

FIG. 6. Photograph taken 3 wk post-procedure, showing a good aesthetic outcome.

FIG. 7. Multiple hemangiomas of the tongue in a 41-year-old woman who was 3 mo pregnant.

FIG. 9. Photograph of the affected area. Complete healing occurred in 14 d without pain or discomfort.

have been used in the treatment of cutaneous and mucosal lesions.[22,23] They have been used to varying extents to treat oral lesions. It has been observed that most hemangiomas stop growing after laser therapy, and that the rate of adverse reactions is very low. Deeper lesions may be more difficult to treat. Landthaler et al.,[24] in a study of hemangiomas treated with different types of lasers, reported that in some cases the deepest part of the lesion could not be treated. Alani and Warren[25] reported on 11 patients with deep vascular lesions treated with intralesional Nd:YAG or KTP laser energy; all patients achieved a marked improvement, with further improvement seen after repeated treatments. Grantzow et al.[26] described a 77%–98% reduction in hemangioma size after percutaneous Nd:YAG laser therapy, depending on the number of treatments. Wimmershoff et al.[27] reported significant shrinkage of lesions in two patients with vascular malformations of the face treated with combined percutaneous and intralesional Nd:YAG laser therapy.

Thus for deeper vascular lesions, lasers with deeper penetration are necessary. In our FDIP procedures we did not penetrate into the mucosa or skin; this method was not found to be effective for deeper vascular diseases, and in our cases the deeper tissues were not affected. We did not include hemangiomas over 3×3 cm in size, and only included those up to 2.5×2 cm. The heat generated by continuous wave diode laser energy is only effective superficially, but it is sufficient to photocoagulate small hemangiomas. In patients with large hemangiomas (those measuring >3 cm in both dimensions, not included in our series), not only must a more invasive technique be used, but first a high-flow hemangioma must be ruled out (i.e., an arteriovenous malformation with a feeder artery that clinically can often be felt as a characteristic thrill upon palpation). Examination with Doppler ultrasound and/or angiography prior to laser treatment of large vascular lesions is mandatory, to ensure that the lesion is of the low-flow type. In case of high-flow lesions, the feeder artery must be identified and occluded, and photocoagulation should only be performed after this has been done.[7] Otherwise there is a risk of hemorrhage that may be life-threatening. However, the vast majority of vascular lesions in the head and neck are small, measuring <3 cm in either dimension, and are of the low-flow type, characteristics that allow laser treatment.[8–10] Indications for laser treatment in our study were rapid uncontrollable growth and functional impairment or cosmetic deformity. Considering that hemangiomas usually spontaneously involute, the clinician consulted with an oral surgeon to determine whether the lesion might cause problems for the patient. Together, they decided whether to observe the patient's lesion to watch for involution, or whether surgery was necessary due to possible complications (e.g., bleeding, pain, or esthetic problems).[28,29]

FIG. 8. Her hemangiomas of the tongue were treated with an 810-nm diode laser at 3.5 W power.

Complications that may occur during treatment include perforation of the mucosa covering the lesion, necrosis, nerve damage, and glandular stenosis, and these should be avoided by taking preventive measures. The fiber tip of the laser should not be held in the same place for too long, but should be passed slowly over the lesion, while watching for tissue shrinkage and blanching. Photocoagulation must be performed while allowing a safety margin that extends slightly beyond the visible extent of the lesion. In this way tissue sloughing, which could lead to hemorrhage,[9] will not occur within the hypervascularized area.

Nerves may also be irreversibly damaged by photocoagulation; thus the use of cryosurgery in areas adjacent to nerves has been recommended, as it is less likely to cause irreversible nerve damage.[9] Likewise, when treating near the salivary gland duct orifices, the risk of post-treatment stenosis must be taken into account. These cases should also be treated cryosurgically.

We present the long-term results of 136 patients who were treated with FDIP using 810–830 nm diode laser energy, depending on the size and anatomical location of the lesion. There were no complications or adverse side effects seen in any of the cases, and 98.53% of the hemangiomas underwent complete remission, with only one (0.735%) partially responding to treatment, and one patient (0.735%) who showed tumor growth. In patients with large lesions, one session was sometimes not enough, and one or two subsequent "touch-up" sessions were necessary. On long-term follow-up there was at least one recurrence, seen 4 y post-procedure in one patient. Follow-up ranged from 2–8 y, with a median of 6 y.

Thus, in selected patients, FDIP appears to be a valuable tool in the treatment of hemangiomas, especially those with rapid uncontrolled growth or those affecting functional areas, and as long as certain precautions and limitations are followed, good aesthetic and functional results can be achieved.

CONCLUSION

To date, there has been no large study of the treatment of hemangiomas with FDIP in the oral cavity. In this study, FDIP was employed to evaluate its use for treating benign vascular oral lesions. We made the following observations: (1) the technique is readily applicable to hemangioma treatment; (2) it is effective for lesions up to 2 × 2 cm in size; (3) there were no side effects or complications seen during surgery; (4) the relapse rate was very low (0.735%); (4) no local or general anesthesia was required; (5) in selected patients the technique has low surgical risk, without bleeding or need for suturing; and (6) good aesthetic results may be achieved. Thus we believe that FDIP is a safe and effective technique for treating oral hemangiomas. However, more studies are needed before FDIP can achieve widespread use in routine clinical practice.

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