CO_2 Laser Treatment of Leukoplakia of the Tongue: A Case Report and Literature Review

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Abstract: Leukoplakia is a potentially premalignant lesion affecting the oral cavity (malignant transformation rate of 24% of tongue cases).[9] The invasive nature of premalignant lesions together with their large and innocuous extent influences the treatment. The common modalities of treatment of these lesions are surgical excision, cryotherapy, and electrosurgery. Diffuse lesions are difficult to manage by excision and can result in severe disability. CO_2 lasers have been in use for about 40 years, and provide some benefits in comparison to conventional surgical procedures. Less pain, little bleeding, minimal postoperative edema, reduced risk of infection, and low recurrence rates were advantages observed following CO_2 laser surgery in the mouth when compared to other modalities of treatment. Here we present a case of leukoplakia of the tongue surgically treated using CO_2 laser. Postsurgical healing progressed well with no postoperative complications; re-epithelialization was complete after 4 weeks. The lesion was kept under observation for a period of 6 months with no recurrence. Thus, we conclude that laser can be considered an excellent form of treatment for the surgical management of leukoplakia.

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The use of lasers in oral and maxillofacial surgery was introduced in 1964 by Patel.[20] In 1970, Polanyi premiered the incision of living tissue with a CO_2 laser.[24] The various soft tissue procedures which can be performed using lasers include:

- Incisional and excisional biopsies
- Periodontal pocket disinfection/reduction with gingival curettage
- Cosmetic crown lengthening
- Gingivectomy and frenectomy
- Soft tissue tuberosity reduction
- Operculum removal
- Ablation of lesions

Advantages include production of a sterile surgical field, minimal cicatrix formation and wound contraction, ability to coagulate, vaporize or incise tissue, good hemostasis, reduced local tissue trauma and edema, reduced pain by induced neural anesthesia, minimized tumor cell dispersion by lymphatic sealing, and reduced damage to surrounding structures.

Disadvantages of lasers in surgery include the need for specialized didactic and clinically oriented instruc-

tion in laser use for the surgeon and ancillary assistants, hazards to the patient and operating team, expensive equipment, maintenance requirements, fire hazard, and electrical hazards of laser equipment.

Four basic interactions of carbon dioxide laser with tissue are absorption, scattering, reflection, and transmission. CO_2 radiation is rapidly absorbed and dissipated, having a minimum penetration depth of 0.02 mm. This results in a system that produces a very accurate effect. [23]

Location of the leukoplakic lesion within the oral cavity (floor of the mouth and lateral border of tongue) may be an indicator of the likelihood of malignant transformation. Management of leukoplakias is far from satisfactory and no large trials offer guidance as to the most reliable treatment. Surgical removal of leukoplakia seems one reasonable option. Some experts surgically remove these lesions with scalpel, laser, or cryoprobe. Laser excision is preferred to fulguration. To treat soft tissue pathology in the mouth with the CO_2 laser, either a handpiece or an operating microscope can be used, and the laser beam can be focused as a cutting tool or defocused to vaporize tissue. It is extremely important to perform histological examination before vaporizing a lesion to establish the diagnosis. Ideally, the lesion should be excised with the laser, and this produces a specimen that can be sent for histological examination. A risk with vaporizing the lesion is that small fragments of pathological tissue may not be completely eliminated by the laser beam. This problem is more likely to occur in an area of thickly keratinized epithelium, which has low water content and is therefore resistant to vaporization by the CO_2 laser. Deep layers may not be completely eradicated and recurrence is likely to occur.[12,13] Removal of the lesion with a carbon dioxide laser down to the basement membrane encourages the regeneration of new, healthy epithelium.

A follow-up study by Schoelch et al[22] employed CO_2 and Nd:YAG lasers with standard laser safety protocols. There was no postoperative infection, hemorrhage, or paresthesia. Two patients developed pyogenic granulomas at the surgical sites. Fifty-five of 70 patients were followed for more than 6 months; follow-up averaged 32 months (range 6 to 178 months). A total of 154 oral leukoplakias from 116 patients were treated and comparisons with the rate of recurrence, malignant transformation and clinical futures, epithelial dysplasia, location, and treatment procedure were examined. To evaluate recurrence and malignant transformation, the cases were restricted to those with a minimum follow-up of 6 months. The rate of recurrence in laser surgery was approximately 29%. Malignant transformation was observed in four of 97 lesions. They were observed in 13.6% of tongue cases and 1.8% of gingival cases. Only 1.2% malignant transformation in laser surgery was found. [22]

Ishii et al[17] reviewed the records of oral leukoplakia patients treated with laser surgery in order to assess its clinical usefulness. It has been reported that the rate of recurrence was 7.7% to 38.1%, while malignant transformation was 2.6% to 9% for oral leukoplakia treated with laser surgery. This suggests that nonhomogeneous leukoplakia on nonkeratinized epithelia, eg, the tongue mucosa, has a high risk for malignant transformation, so lesions should be excised after detecting abnormal epithelia using vital tissue staining. The wound healing process after laser surgery was satisfactory and no significant complications were observed.[17]

CASE REPORT

A 58-year-old male patient reported to the Oral Medicine, Diagnosis and Radiology Department of M.A. Rangoonwala Dental College, Pune, with a chief complaint of missing teeth, and wanted prosthetic treatment. Additionally, the patient reported a history of habitually smoking bidis (traditional form of smoked non-filtered tobacco with betel leaf) 20 to 30 times a day for the past 40 years, which he had discontinued six months previously. No other relevant history could be recorded.

Upon examination, the patient was completely edentulous. He had a non-scrapable whitish brown lesion on the anterolateral part of the dorsum of the tongue, measuring approximately 2.5 x 4.0 cm and having an irregular shape. The lesion had diffuse borders with reddish areas interspersed. The lesion was symptomless and had been present for many years (Fig 1). A provisional diagnosis of leukoplakia was made.

The patient was referred for routine blood investigations. The report was unremarkable, except that the hemoglobin level was 11 gm%.

The patient was then scheduled for laser surgery using CO_2 laser. The extent of the lesion, patient's age and systemic health status were the deciding factors for the choice of treatment modality.

Patient safety was ensured using protective eyewear, and the area surrounding the lesion was covered with wet gauze. After adequate local anesthesia was administered, an outline of the lesion was made around 0.5 to 1.0 mm beyond its clinical extent (to compensate for the zone of thermal coagulation) in a slow and con-

Fig 1 A non-scrapable whitish brown lesion on the anterolateral part of the dorsum of the tongue measuring approximately 2.5 X 4.0 cm and having an irregular shape. The lesion had diffused borders with reddish areas interspersed.

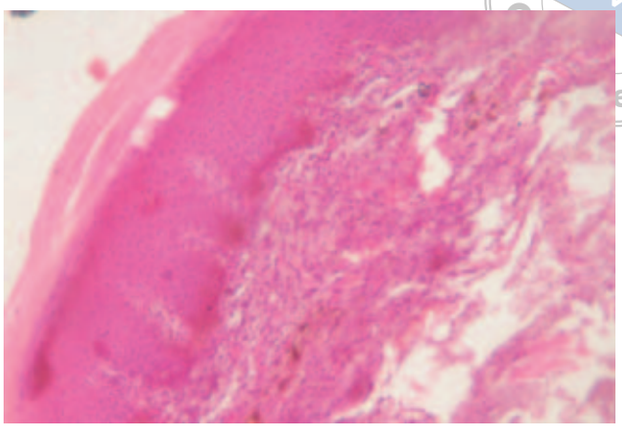

Fig 2 H & E stained section showing hyperkeratinized stratified squamous epithelium, proliferated and showing drop-shaped rete ridges at places, dysplastic features such as basilar hyperplasia, nuclear hyperchromatism and increased nucleo-cytoplasmic ratio are evident. The basement membrane appears to be intact. The connective tissue is fibrocellular with collagen fibers, fibroblasts and blood vessels. There is mild to moderate chronic inflammatory cell infiltrate.

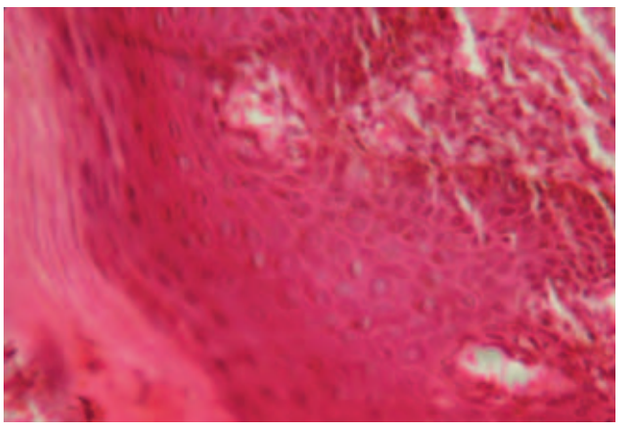

Fig 3 400X magnification of the section shown in Fig 2.

trolled fashion, using rather low-level continuous wave irradiation of wavelength 10,600 nm at 2 W (Union Medical, Korea) in noncontact mode. Then excision was carried out with a desired depth of 12 mm. The procedure was painless and well tolerated by the patient.

The patient was discharged after ensuring complete hemostasis and was advised to use chlorhexidine mouthwash. Analgesics were given as required to control postoperative pain.

The specimen was sent for histopathological examination. H & E stained slides showed hyperparakeratosis with dysplastic features and an intact basement membrane (Figs 2 and 3). The clinical and histopathological findings were correlated and a final diagnosis of leukoplakia was made.

The patient was followed-up regularly for six months (3rd, 10th, and 21st days postoperatively, and after 6 months) (Figs 4 to 7) with no postoperative complications and a complete resolution of the lesion.

DISCUSSION

The World Health Organization first defined oral leukoplakia as a white patch or plaque that could not be characterized clinically or pathologically as any other disease; therefore, lichen planus, candidiasis, and white

Fig 4 On examination the lesion was inflamed, edematous, and covered with slough, with no pain or postoperative complications.

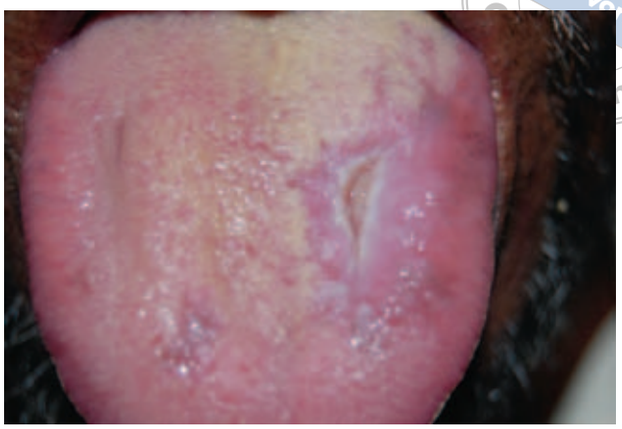

Fig 5 Patient shows signs of healing with pale pink granulation tissue, although the presence of tissue tags and slough was seen in the center of the lesion; with no pain or complications.

Fig 6 Patient showed complete healing and resolution of the lesion.

Fig 7 No loss of function, no neurological deficit, re-growth of papillae, no scar tissue seen.

sponge nevus were excluded. Since 1983, the WHO definition reads: Leukoplakia is a whitish patch or plaque that cannot be characterized clinically or pathologically as any other disease, and is not associated with any physical or chemical causative agent, except the use of tobacco.[2]

Our case was at stage III according to modified LCP classification given by van der Waal;[16] there was a diffuse whitish discoloration of the dorsum of the tongue near the midline. The lateral areas were erythematous with localized loss of tongue papillae.

It is well known that leukoplakia is more common in males, with ratios up to 5.29:1.3 However, a recent report[6] showed that the sex ratio has altered, with the male rates falling proportionally more than female rates. The affected area in our patient was the dorsum of the tongue, which is in agreement with previous research.[11-14] Bánóczy[4] suggested that the most common site for leukoplakia is the commissure (42%), followed by the buccal mucosa (22%) in males, and the buccal mucosa (40%) and commissures (19.2%) in females. It is well accepted that certain sites carry a higher risk of malignant transformation.

Various surgical as well as nonsurgical treatment options are available for leukoplakia. These include scalpel surgery, laser surgery, cryosurgery, electrocautery, fulguration, and medicinal therapy with antioxidants. Perhaps the general consensus is that surgical excision of oral leukoplakia is the best treatment for this lesion. Among the surgical treatments, CO_2 laser surgery is the technique of choice.[8] Laser excision is suitable for leukoplakia cases on nonkeratinized epithelia (eg, the tongue and buccal mucosa).[18]

The use of the CO_2 laser, in spite of some advantages, seems to have the same problems as other surgical and nonsurgical techniques in the treatment of invasive lesions. However, the CO_2 laser is helpful in preventing intra- and postoperative complications. Moreover, the recurrence rate is low.[7-15] The laser reduces the amount of intra-operative bleeding compared to conventional techniques and eliminates the need for suturing the mucosa or grafts, which require in-patient treatment.

Re-epithelialization following laser surgery is achieved with minimal wound contraction.[21] Due to its high temperature, the CO_2 laser beam results in a sterile and noncontaminated wound. Lasers produce a sterile surgical field based on instant vaporization of tissue and adjacent vascular and lymphatic sealing. Furthermore, it helps in preventing the seeding of the dysplastic cells in adjacent soft tissue areas.[1,5,19]

Studies have shown that histologically, there are few myofibroblasts present, which appears to be responsible for less scar contraction.[10,21] In addition, less collagen formation is noted and there is delayed epithelial regeneration. Prolonged pain and scar formation is often observed when electrocautery is used because of tissue necrosis.[21]

Oral CDx is a new noninvasive laboratory diagnostic technique for the evaluation of common unexplained white and/or red tissue lesions that may be precancerous or cancerous, despite their innocuous appearance. It involves the use of a firm brush rotated clockwise over the lesion to get the complete transepithelial biopsy. This method detects potentially cancerous lesions at a very early stage. We can use this diagnostic technique to detect the atypical cells and once confirmed, the laser treatment can be initiated. Thus, adding a diagnostic technique like Oral CDx could detect cancer at a very early stage and help treat leukoplakia-like lesions with enhanced accuracy.

CONCLUSION

Oral leukoplakia is a potentially premalignant lesion which needs expert management. Successful treatment with CO_2 laser requires that the operator possess adequate skills, knowledge, and training in laser use. However, the device does not cure the disease. The appropriate use and surgical selection based on sound clinical judgement are responsible for elimination of the disease process.

Management of oral leukoplakia with laser surgery prevents not only recurrence and malignant transformation, but also postoperative dysfunction. Hence, it can be considered as an excellent procedure that is able to overcome many problems encountered in various other treatment modalities, as discussed above.[17]

We would like to propose that the management of leukoplakia could be initiated by the additional procedure of OralCDx® (CDx Laboratories, Suffern, NY) Oral Brush Biopsy. This will not only help in early detection of dysplastic changes, but will also prevent unnecessary loss of normal tissue at the depth of the lesion.

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