

LASERS IN THE TREATMENT OF ORAL MUCOSAL DISEASES: A LITERATURE REVIEW

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ABSTRACT

The aim of the present paper was to undertake a literature review regarding the use of lasers for treating commonly oral mucosal diseases including leukoplakia, mucositis, pyogenic granuloma, burning mouth syndrome, hemangioma, fibrous hyperplasia, mucocele, papilloma and frenectomy. We detail the advantages and limitations compared with conventional treatment. We searched PUBMED database with the keywords Laser, treatment and the above mentioned diseases between the years of 1985 to date. Articles without abstract were excluded. A total of 79 papers were selected. There are few studies published in this subject. In addition, the number of randomized controlled studies comparing the use of lasers and conventional therapy are scarce, the majority being case reports and small number of longitudinal prospective work. Scientific literature seems to sustain some benefit in the use of laser in the treatment of a variety of oral mucosal diseases. However, more appropriate and well-designed studies are necessary in order to advocate this modality of treatment particularly when it is taken into consideration the amount of financial resources needed to operate such equipments. Treatment with lasers may present some advantages compared to conventional modalities once it may reduce trans and post-operative morbidity. However, more adequate research is necessary in order to prove its benefit.

KEYWORDS: Oral medicine, oral surgical procedures, laser therapy, soft tissue lesions.

1. INTRODUCTION

In oral pathology, lasers dispositive can offer important advantages, especially on the treatment of certain lesions¹. These advantages includes a higher precision on tissue excision, disinfection of the surgical area, reduction of edema and physical scarf, without a necessity or decreasing the quantity of suture, hemostasis and reduction or elimination of postoperative pain^{2,3}.

The majors lasers of high power are recommended for oral surgeries in soft tissue are the Nd:YAG and CO₂⁴. Both can be used on frenectomy, lesion ablation,

removal of the gingival operculum, incisional and excisional biopsy, gingivectomy and gingivoplasty³.

Despite the literature, mention the superiority of laser in comparison with the conventional surgery, this requires a complementary study that proves its effectiveness and applicability on the oral cavity lesions^{5,6}.

The aim of this study was to conduct a literature review about the use of laser for the treatment of some oral pathologies as alterations of the normal standards, such as: leukoplakia, mucositis, pyogenic granuloma, burning mouth syndrome, hemangioma, fibrous hyperplasia, mucocele, papilloma and frenectomy.

2. MATERIAL AND METHODS

The literature review was carried out in two stages: the first was a review of the literature on certain oral pathologies and the second, a review including clinical studies that evaluated the use of high power laser during dental surgeries, observing limitations, advantages and behavior of the tissues irradiated by the laser.

The following internet databases were used: Medline, Lilacs, PubMed and Scielo, from 1985 to 2014. During the analysis and selection, the information contained in the texts, statistical significance, consistency and the data presented by the authors.

3. LITERATURE REVIEW

Oral mucosites

The oral mucositis is an inflammatory response of the oral mucous, being a secondary detrimental effect to treatments with anti-neoplastic drugs or usage of ionizing radiation, on neoplastic diseases of head and neck.

Lino *et al.* (2011)⁷, reported the efficiency of the laser phototherapy (LPT) on the treatment of oral mucositis induced by RT (radiotherapy) after the surgical removal of the carcinoma of squamous cells with bone invasion of the jaw. The lesions of the palate and commissural were treated with LPT λ660 nm, 40 mW e Ø = 4 mm², in contact mode, 5 x 2,4 J/cm² per

point, 14,4 J/cm² per section. For the treatment of the lesions on the nasal mucous, the dose utilized were of λ 780 nm, 70 mW and $\emptyset = 4 \text{ mm}^2$, 3 x 2,1 J/cm² per point, 6,3 J/cm² per section, in contact mode, applied on the outside area of the nose. One single dose (2,4 J/cm²) with the laser λ 660 nm, as was described before, was applied on the entrance of each nostril. A LPT was used 3times/week during 4 weeks. After the treatment, the study had concluded that a significant improvement in relation to the pain symptoms, difficulty of swallowing of solids and liquids, as a progressive decrease on the gravity of the lesions, which allows the patients the return to daily activities, an improvement on the quality of life and an adherence to radiotherapy treatment.

Elad *et al.* (2011)⁸ evaluated the efficiency of the dispositive of a new visible light therapy (MLV) to prevent oral mucositis in patients undergoing to transplantation of hematopoietic stem cells (TCTH), having good results in relation to the level of pain and acceptance of the patients of the group undergoing to the laser treatment, as the level of gravity of the lesion in relation to the control group.

According to the meta-analysis held by Figueiredo *et al.* (2013)⁹ it is possible claim that the LT, when applied on patients undergoing to oncotherapy, is efficient on the control of Oral Mucositis on advanced degrees, demonstrating the importance of prevention imposed by the oral mucositis degree ≥ 3 , which can even lead to the non-adherence and consequently interruption of the treatment. On the other hand, the randomized clinic assay published by Lima *et al.*, (2012)¹⁰, concluded that the therapy with low intensity of laser was not efficient on the reduction of oral mucositis on advanced degrees, although a marginal benefit cannot be exclude in terms of reduction on the interruptions of the radiotherapy, which can translate into a greater efficiency.

Hemangioma

The hemangiomas are the mesenchymal tumors formed by blood vessels, which exhibit an increase on the cellular proliferation¹¹. It grows quickly, regress slowly, and never reappear. All the three phases of the life cycle of an hemangioma are characterized by a single set of markers and biological processes, which are: (1) proliferative phase (0 to 1 year of age), (2) involution phase (1 to 5 years of age), and (3) involute phase (>5 years of age); however, the spontaneous involution can be incomplete and around 15% to 20% of the residual lesions can remain¹². A total of 65,3 % of the affected patients is children and approximately 20% of the patients have multiple lesions. On average, 80% of the lesions are localized on the head and neck regions and the mucous membranes are involved in 10 % of the cases (JINNIN, ISHIHARA, BOYE *et al.* 2010)¹³.

According with Van Doorne *et al.* (2002)¹⁴ many therapies have been administrated on the treatment of vascular lesions, including oral corticosteroids, intralesional injections of fibrosing agent, therapy with alpha interferon 2 b, treatment with laser and embolization.

The usage of lasers of diode and Nd: YAG laser in surgeries of soft tissues of the oral cavity is extremely useful due the fact that it is highly absorbed by the chromophores, as hemoglobin, melanin, and collagen, and also due the cutting capacity, coagulation, and hemostasis, with a higher capacity of tissue ablation and similar properties of the laser of potassium titanium phosphate (KTP)¹⁵. Thus, the laser is currently considered the gold standard for the treatment of the major part of vascular lesions.

Transmucosal thermo-coagulation is a technique without accent, widely used for the treatment of vascular lesions. The energy of the diode laser is continually liberated by a flexible optical fiber, which is slowly moved over the lesion, by a distance of 2 to 3 mm from the surface and should not be used on the same place for a long period of time. The lesion regresses during the treatment. This effect is called the “forced dehydration”, and occurs due the increased absorption of laser energy by the hemoglobin on the interior of the lesion. As it passes through the tissues, the laser beam generates heat and, so, coagulates the tissue to a depth of around 7 to 10 mm, a process called photocoagulation where, a dehydration and whitening of the hemangioma can be observed on immediate post-operative¹⁶.

Different authors¹⁵⁻¹⁸ recommend the technique of the endoluminal sclerosis for hemangiomas on the orofacial area. Lapidoth *et al.* (2005)¹⁷ even combines the use of intralesional diode laser with radiofrequency, with a rate of success of 90%, with few post-operative complications. The success rate of 95,24% for one or two sections of treatment is referred by Torres *et al.* (2010)¹⁸.

On the study of Álvarez-Camino *et al.* (2012)¹⁹ it was performed on a single section the application of the intralesional diode laser through the active optical fibre of 1W on continuous mode, insert into the interior, through one intramuscular needle injection, from the most depth portion to the surface of the lesion. From a total of 10 hemangioma cases on oral mucous, with an average age of 25,4 years, in 8 cases it was made necessary only one section, before the clinical verification of a total reduction of the size of the lesion. In two cases, were necessary at least 2 sections of intralesional photocoagulation to reach a satisfactory static result. There was no complication of any kind. After a follow-up period of at least 6 months, only one case of recurrence was described. It was concluded that the treatment of the lesions by the endoluminal diode laser is a practical, quick, simple, minimally invasive technique, held by local anesthetics at ambulatory, with low rates of complications.

Thus, the intralesional photocoagulation should be considered an excellent to other modalities well established for the treatment of oral hemangioma²⁰.

Nuño-González *et al.* (2011)²¹ in his cross-sectional observational study of a series of 11 patients with venous malformation on the mucous, treated with a single section of Nd: YAG laser, concluded that the therapy is quick, secure and relatively easy to learn besides does

not causes bleeding. The post-operative discomfort is minimum, as the potential of occurring scars. Therefore, for these authors, the Nd: YAG lasers are the choice of approach on the treatment of vascular lesions of the mucous.

Leukoplakia

Leukoplakia is a common mucous pathology with power of 0,1- 17 % of risk of malignant transformation^{22,23}. Etiology of the leukoplakia still is not clearly established. Smoking, alcohol abuse, mechanic injuries, infection by *Candida albicans* and the different locations of galvanic potential are reported as most important casual factors^{23,24}.

As its etiology cannot be established, the treatment is difficult and shows insufficient efficiency^{25,26}. However, the possibilities of treatment include the resection of the lesion, cryotherapy, use of laser, as well as administration of vitamin A and retinoids.

Lodi *et al.* (2008)²⁷, through a systematic literature revision, addressed the different modalities of the treatment of leukoplakia, aiming to compare the results between affected patients by oral leukoplakia, submitted to medical treatments or surgical, or both (group of study), in relation to patients which has received placebo or any treatment (control group). Among the therapeutic modalities evaluated on the group of study, were: the surgical removal of the lesion, including the traditional surgical excision, laser surgery, cryotherapy; topical treatment, including anti-inflammatory, antifungal agents, carotenoids and retinoids and cytotoxic agents; systematic treatment; removal of predisposing habits, as example, tobacco and alcohol; other treatment, as photodynamic therapy and last, combined treatment. Such authors concluded that until the moment there is no evidence of efficient treatment on the prevention of malignant transformation of the leukoplakia, the treatment can efficient on the resolution of the lesion, however, malignant alterations and adverse effects can occur.

In the last years the photodynamic therapy has been introduced as a new method of alternative treatment for the lesion. The photodynamic therapy uses the light that has a defined wavelength to activate the photosensitizers accumulated on the cells^{28,29}.

On the study of Pietruska *et al.* (2014)³⁰, twenty three patients with age between 21 and 79 years were included, in which 44 flat homogenous lesions, clinically diagnosed and histopathologically confirmed as leukoplakia, were submitted to photodynamic therapy held with the utilization of the photo sensitizer Photolon®, containing 20 % of cloro-e6 and 10 % of dimethylsulfoxide and a semiconductor laser, with power up to 300 mW and wavelength of 660 nm. Ten sections were performed utilizing the superficial density of light energy of 90 J/cm². On the initial evaluation the average size of the lesion were of 6,5cm ± 2 while after the photodynamic therapy the average size were of 3 cm ± 2,99 centimeters with significant reduction (an average, 53,8 %) of the size of the lesion, observed after

the therapy. Eleven (27,27 %) remains unchanged. The authors still report that there were no adverse local effects during the treatment and conclude that the photodynamic therapy with the use of cloro-e6 can lead to a considerable reduction of the leukoplakia oral lesions being useful on the clinical practice.

The usage of CO₂ laser has turned the base of the treatment of leukoplakia and pre-cancerous lesions all over the world and has demonstrated efficiency and with low morbidity³¹, and can be better obtained by ablation or vaporization of the lesion³².

On the study performed by Tambuwala *et al.* (2013)³² thirty patients with bilateral lesions was allocated into two groups, one experimental, where was performed the excision of the lesion utilizing laser of carbon dioxide and a control group where the excision of the lesion was performed with scalpel. The authors concluded, through this study, that the CO₂ laser replaces the conventional scalpel in terms of better intra-operative bleeding and reduction on the formation of scars, however, in relation to the post-operative pain and edema after the excision the laser has not shown a statistically significant difference than the scalpel.

Pyogenic granuloma

Pyogenic granuloma is a mucocutaneous benign lesion relatively common. The term is a mistake once the lesion does not contain pus and it is not granulomatous. The most common intraoral site is the gum margin, but the lesions have been reported on the palate, oral mucous, tongue and lips³³.

The lesion appears as a non-neoplastic growth, the choosen treatment being the excisional therapy, but some alternatives approaches, such as cryosurgery, the excision by ND: YAG injection of corticoid or ethanol, and sclerotherapy with sodium tetradecyl sulfate has also been reported as efficient³⁴.

The study of Rai *et al.* (2011)³⁵ reported a case of a patient with 50 years of age with lesion on the gum between the elements 23 and 24 which was treated with diode laser produced by Picasso (Kavo, US), with the following specifications: wave length of 808 nm ([+ or -] 10), the energy production 0,1- 7,0 W, and entrance power of 300 VA. The wavelength that was utilized was of 810 nm and 7 W of power, maintaining the pulse mode continue/ interrupted. The local anesthetic was not utilized. The tip was maintained at a distance of around 1 mm from the soft tissue during the process, and took 4-5 minutes to completely excise the lesion. It was not prescribed any antibiotics, anesthetic or anti-inflammatory on the post-operative. The cut off mass was sent to histopathological and there was a complete resolution of the lesion without any complication. Therefore, the authors concluded that the diode laser could be a good therapy option to intraoral pyogenic granuloma.

White *et al.* (1991)³⁶ proposed that the excision with laser is well tolerated by the patients, without adverse effects. They also state that the CO₂ and irradiation with the Nd: YAG laser it is successful on the surgical

treatment³⁴. The diode laser has shown excellent results on cutaneous pyogenic granuloma with minimum pigments and textural complications. Gonzales *et al.* (1996)³⁷ demonstrated compensation both symptomatic as clinical of the lesions, with excellent cosmetics results with 16 of 18 treated patients. However, there is not a minimum convincing proof of its efficiency on intraoral pyogenic granuloma.

Burning mouth syndrome

Burning mouth syndrome is a common disease that represents a diagnostic and therapeutic challenge for the clinical. It is clinically characterized by the burn sensation on the tongue or other oral sites, many times without clinical and laboratory findings¹.

The pilot study of Romeo *et al.* (2010)³⁸ investigated the bio stimulator effect of the laser therapy of low intensity could improve the quality of life of these patients with burning mouth syndrome. Among 160 affected patients by the oral burning sensation, treated on the operative oral pathology unit on the science department complex of stomatology at Sapienza, University of Rome, 77 belonged to the neurological subgroup. Twenty-five of these patients, 16 of the female sex and 9 of the male sex, were random selected for the application of laser of low power. All the patients were irradiated with diode laser (Lumix 2 Prodent, Italy) contemporaneously emitting at 650 nm and 910 nm, with a fluency of 0,53 J/ cm during 15 minutes, twice a week during 4 weeks. The irradiated areas were the tongue edges towards the taste fibers. The authors reported that seventeen patients (68%) had relevant benefits from the treatment, however concluded that more investigations are necessary to clarify, for a bigger number of cases and control group, the real efficiency of this innovative therapy.

The study performed by Santos (2011)³⁹ aimed to evaluate the effect of low intensity laser on the treatment of burning mouth syndrome. For this, ten patients diagnosed with this syndrome were included on the study. All of these patients were submitted for a weekly section of LBI during 10 weeks. It was utilized a continuous wave length of 660 nm, power of 40 mW, 20J/cm², 0,8J/ point, with irradiation of each point during 10 seconds. In all sections the intensity of oral burning sensation were evaluated with an analogical visual scale of 10-cm (VAS), with 0 indicating none symptom and 10 indicating the worst burning sensation possible. This evaluation of intensity by VAS was performed immediately before and immediately after each section of laser therapy of low intensity. In accordance to this, the authors considered the laser therapy as an alternative treatment to relief the oral burning on patients with burning mouth syndrome.

Mucocele

Mucocele is a benign cystic lesion caused by the disruption of the minor salivary glands duct on the oral cavity, generally occasioned by mechanic trauma. Can present pink or bluish coloring⁴⁰ and occurs in any

region of the oral mucous, generally on the intern surface of the inferior lip, floor of the mouth, ventral surface of the tongue and soft palate. It does not exist gender preference and can occur in any age, but studies report that the second decade has a higher incidence⁴¹.

The treatment can be done through conventional surgery, cryotherapy, laser surgery and laser vaporization⁴⁰.

Yagüe-García *et al.* (2009)⁴² performed a clinic non-randomized assay aiming to compare the results obtained after the resection of the oral mucocele with the scalpel and the CO₂ laser. Among 68 patients studied with histological diagnose with mucocele, 38 lesions were resected with scalpel and the other 30 with the CO₂ laser. Between the cases of conventional surgical removal of mucocele, the recurrence was registered on 8,8% of the cases, and 13,2% of the patients suffered post-operative complications, being more frequently the presence of fibrous scars. There was no complications or relapse after the minimum accompaniment of 12 months on the submitted cases on the treatment with CO₂ laser. They concluded that the ablation of the oral mucocele with CO₂ laser offers results more predictable and with less complications and recurrence then the convention resection with scalpel.

Huang *et al.* (2007)⁴³ through the non-controlled clinical assay with 82 patients diagnosed with mucocele on the inferior lip treated with CO₂ laser, observed that there was relapse in 2 cases, with rare complications, with exception of 1 case of paresthesia, minimum scars formations and absence of bleeding. Wu *et al.* (2010)⁴⁴, in a retrospective study with 64 patients, in which 30 were treated with vaporization of the CO₂ laser and 34 patients with surgical excision, observed rates of relapse of 6,67 % and 5,88 % respectively, without statistically considering difference between the two groups.

Cases reports^{40, 45} conclude that treatment with laser is efficient to avoid relapse of mucocele, promotes reduction of post-operative pain, without necessity of suture and reduced surgical time. Thus, with the incidence of mucocele in children is relatively high, the authors claim that the laser therapy could present improvement on the relation to others pediatric dentistry treatment techniques.

Squamous cell papilloma

Papilloma represents a benign oral lesion with epithelial origin, normally associated with infection with the human papilloma virus (HPV) type 6 or 11⁴⁵. The HPV is considered a risk factor for the development of carcinomas. Thus, is primordial the correct diagnostic of papilloma, since many lesions caused by HPV can turn to malignant and show a high rate of cure when treated early⁴⁶.

There are few studies on the literature that evaluates the treatment of papilloma with high power laser and/ or compare with conventional surgical techniques. Baeder *et al.* (2012)⁴⁷, evaluates the diode laser effects for the removal of oral lesions caused by HPV and the effects caused by the viral load after the process of healing of

the tissue on comparison with the conventional surgery involving electro cauterization. The sample was composed by 5 patients that had obtained 2 distinct lesions caused by HPV, in which were control cases of their own composed the sample. All the patients were submitted both electro cauterization, and also the diode laser. Passed 20 days of the lesion treatment, were collected the samples for analysis of the viral load. The authors observed the presence of virus in all samples, however the surgeries with laser revealed a significant reduction on the quantity of virus per cell in comparison with electro cauterization.

Angiero *et al.* (2013)⁴⁸ evaluated the efficiency of therapeutic of the laser on oral papilloma lesions. They selected 174 patients with lesions of intraoral and lip HPV and performed the excision with diode laser in different wavelengths (810-980 nm), with an average of power of 2,1 W in continuous emission mode. In 95,4 % of the cases there was a complete cure on the first 30 days, there was a relapse on 1 case, in which was treated later with success, and an average VNS score for evaluation of pain was inferior of 1.

In turn, Boj *et al.* (2007)⁴⁵, in his case report, described the excision of a lesion of squamous cell papilloma utilizing the ER, Cr: YSGG laser. In the present case, a minimum quantity of local anesthetics was utilized, there was no necessity of anesthetics medication after the surgery and the wound healing occurred rapidly.

The success of the laser of high power on the treatment of papilloma can be explained by the photo-thermic effect, so, the conversion of electromagnetic energy of the bundle of laser on heat. This effect triggers tissue alterations that are observed on the cutting edge, where the temperatures are between 60 °C and 100 °C, reducing the quantity of infected tissue. The photocoagulation can, so, induce on the denaturation of viral proteins, destruction of the virus and at the same time, complete removal of the papilloma⁴⁸.

Therefore, the treatment of the viral lesions, the laser appears essential, because besides eradicating lesions, promotes a reduction of relapse, because acts directly over the viral load, reducing it^{16,47}. Moreover, the laser of high power is associated with a minor necessity of local anesthetics and suture, reduce surgical time, hemostatic effect, excellent visibility of the surgical area and reduction of pain and post-operative edema⁴⁵.

Frenectomy

Frenulum are folds, have congenital origin, composed by fibrous tissue, muscular or fibromuscular, covered by a mucous membrane⁴⁹. In normal conditions, the frenulum does not cause pathological consequences, however, the presence of anomalous frenulum can be trigger a series of prosthetic alterations, orthodontics, phonetics and of periodontal nature^{49,50}. The surgical removal of the frenulum, named frenectomy, can be performed by conventional scalpel mode, with electric scalpel or by the surgical lasers^{51,52}. The principals effects observed on the surgeries of soft tissue

performed by the usage of scalpel and cold blade are pain and bleeding which, although is in small intensity, leads, on most times, the necessity of suture⁵³.

Meanwhile, the laser has demonstrated to be a secure alternative, efficient and acceptable on frenectomy. Haytac & Ozcelik., (2006)⁵² in a prospective study with 40 patients the authors looked to evaluate the degree of post-operative pain, such as de discomfort and functional complications, experimented by the patients that were submitted to frenectomy with CO₂ laser compared with the ones that has received the conventional surgery with scalpel. The results indicated that patients treated with CO₂ laser had less post-operative pain and less number of functional complications in comparison with the patients treated with the conventional technique.

Studies as the Kara (2008)⁵⁴ revealed a significant decrease on the degree of fear on frenectomy performed with the Nd: YAG laser in relation to the conventional technique. On the other hand, Junior *et al.* (2015)⁵⁵, pointed some advantages on the realization of labial frenectomies with Nd: YAG laser, with an absence of trans-operative bleeding, not necessity of suture, as well as a significant reduction of the surgical time when compared to the conventional technique. However, despite the large part of the literature present the superiority on standards of clinical post-operative such as pain and oral function when using laser, in this study this could not be observed. The same study also strove to the fact that bone problems can occur, regarding that the Nd: YAG laser is characterized by an important dissipation of thermal energy³⁶ and, the periosteum and superior jaw are in close contact with the mucous of papillary gum, making difficult the excision of this papillary region; because the laser ray should not reach the periosteum or the bone structure, to not provoke local necrosis.

Inflammatory fibrous hyperplasia

The inflammatory fibrous hyperplasia (IFH) is a benign proliferative lesion, of high frequency, which occurs in response to chronic injuries of low intensity (FALCÃO, LAMBERTI, LORENS, *et al.* 2010)⁵⁶. Its appearance is frequently associated with the usage of dental prostheses badly adjusted or with suction chamber⁵⁷. The treatment of choice consists on the removal of the irritant agent, conventional surgical removal, microabrasion, cryotherapy and laser^{57,58}.

Few studies on the literature evaluate and/or compare the surgical removal of the IFH with laser in relation to conventional surgical techniques. In a retrospective study, Tamarit-Borras *et al.* (2015)⁵⁹ evaluated the advantages and disadvantages on the use of CO₂ laser, diode laser, laser Er: YAG and cold scalpel on the removal of fibrous hyperplasia and pointed the CO₂ laser being the treatment of choice, thanks to the benefits observed on the trans and post-operative.

Pedron *et al.* (2007)⁴⁰, is his case report, described the excision of a lesion of IFH, localized on the groove background, on the right anterolateral region, utilizing

the Nd: YAP laser and observed a good evolution of the case, absence of post-operative discomfort, as well as good tissue reparation, suggesting that, the administration on laser on IFH lesions is a rapid procedure, secure and is an important tool on the clinical care of the dentist surgeon.

4. CONCLUSION

The literature analysis shows that the treatment using laser represents an efficient alternative, secure and promising in Dentistry, especially for the treatment of oral lesions, being capable of replacing conventional treatments or completing them. This tool could present superiority to the conventional therapy, because it seems to reduce the trans morbidity and post-operative, when used correctly. For this, the various types of lasers should be better explored and harnessed to obtain the maximum benefit in terms of technology, patient acceptance and post-operative characteristics. Thus, more research is needed to obtain a complete knowledge and standardization of the technique, as well as satisfactory clinic results.

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