

Laser Dentistry

Effectiveness of low-level laser therapy in the treatment of TMJ disorders acute and chronic: a double-blind study

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Aim: The purpose of the study is to evaluate the effectiveness of Low-Level Laser Therapy in reducing joint and muscle pain in patients with acute and chronic temporomandibular dysfunction.

Methods: The study was conducted on a sample of 180 patients. The sample was divided into two groups according to the time of onset of the disease: acute TMD (<6 months) and chronic TMD (> 6 months). The treatment for all patients provided for the irradiation with Diode Laser Wiser Doctor Smile with tip plane wave at wavelength of 830nm, continuous beam to 40nW diameter and radius of 6mm. The irradiated areas were the joint area, temporal, masseter and pterygoid. The irradiation time for each zone was 60s. The protocol adopted consisted of two weekly treatment for six weeks. Pain assessment was performed using the Visual Analog Scale (VAS), in which different scores (s) depending accused of pain by the patient: s0 no pain, s1-3 mild pain, s4-6 moderate pain, s7-9 severe pain and s10 excessive pain. The pain monitoring was performed before treatment, after 15 days and after one month.

Results: The sample included 80 patients with acute TMD and 100 with chronic TMD. The sample belonging to acute TMD group before treatment, was distributed as follows: 0% in s0; 12,5% in s1-3; 31.3% in s4-6; 53.6% in s7-9 and 2.5% in s10. After 15 days the distribution was as follows: 6.25% in s0; 47.5% in

s1-3; 20% in s4-6; 26.3% in s7-9 and 0% in s10. After 30 days the sample was well distributed: 35% in s0; 45% in s1-3; 10% in s4-6; 10% in s7-9 and 0% in s10. The sample belonging to the chronic TMD group, at time zero, was as follows: 0% at s0; 48% in S1-3; 35% in s4-6; 15% in s7-9 and 2% in s10. After 15 days the distribution was: 29% in s0; 28% in S1-3; 33% in s4-6; 10% in s7-9 and 0% in s10. After 30 days the sample was well distributed: 45% in s0; 36% in S1-3; 15% in s4-6; 4% in s7-9 and 0% in s10.

Conclusion: The Low-Level-Laser-Therapy is a valuable tool that can significantly decrease the perception of pain in patients with temporomandibular joint dysfunction, acute and chronic

Upper and lower lip vascular venous malformation treated by 915 nm N.I.R. Diode laser

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Aim: Vascular abnormalities (VA) are one of the most challenging diagnostic and therapeutic riddle in the head-neck region. The low-flow abnormalities have a prevalence of 1% and the venous malformations (MV) are half of overall vascular malformations in this region. The MV can be located everywhere in the



oral mucosa, however, they are mostly placed on lips and cheek mucosa. Recent studies suggest the use of diode laser to treat some of these abnormalities in mini-invasive way; our aim was to evaluate the efficacy of a 915 nm Near Infrared (N.I.R.) diode Laser in treating lip MV with transmucosal thermocoagulation technique.

Methods: Data on patients with upper and lower lip venous malformations treated in the Oral Surgery Unit through 915 nm NIR diode laser have been collected focusing on intraoral / perioral location, size, number of sessions required, local anesthesia need, post-operative pain reported using Numeric Rating Scale (NRS), intra-operative and post-operative bleeding occurrence and prognosis. Patients were treated by means of laser photocoagulation using a 400 µm uninitiated optic fiber in defocalized / non-contact mode. According to International Society for the Study of Vascular Anomalies Guidelines, the diagnosis of vascular venous malformation was established by collecting the natural history of abnormalities as well as investigating some parameters such as location, size, color, compactness, aspect, presence of pulsatility, shudder and murmur. In case of uncertain diagnosis or when the abnormalities were medium or big in size Ecocolor-Doppler as further instrumental examination was required.

Results: From June 2015 until November 2016 11 MV in 8 patients (5 M/ 3 F, mean age 66) referred to our Department were treated with 915 nm diode laser. Five lesions were perioral and six MV were located intraorally with a mean diameter of 5,6 mm and 6,7 mm respectively. Patients were treated under local anaesthesia (mepivacaine hydrochloride without adrenaline), save four lesions (2 perioral and 2 intraoral, 36,4% of the sample) which did not required local infiltration of anesthetic. In all cases only a single laser session was needed to treat the MV and intra-operative or post-operative bleeding nor any other complications occurred. Aesthetic functionality was preserved and no scar tissues were observed on vermillion and oral mucosa. Furthermore, thanks to the hemostatic effect of laser, all patients did not required surgical suture. Our patients showed a slight post-operative pain (mean NRS value = 2,3) and, in all cases, complete healing of soft tissues was accomplished within 28 days.

Conclusion: Concerning venous malformations with lip involvement, Transmucosal thermocoagulation technique using the 915 nm N.I.R. Diode Laser is an effective and safe therapy which enable to treat MV in a minimally invasive and well-tolerated way, preserving function and aesthetic.

Mesenchymal stem cells' proliferation and differentiation stimulated by low level laser

therapy: a systematic review

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Aim: Mesenchymal derived stem cells have emerged as a popular and versatile tool in the field of regenerative medicine and a growing interest as been shown for their use in tissue's engineering. Low Level Laser Therapy (LLLT) has been used in in vitro and in vivo experiments in order to stimulate cell proliferation and cell differentiation. This study aims to assess, through a systematic review of the literature, the effects of LLLT on proliferation and differentiation of mesenchymal stem cells.

Methods: Following 14 MeSH terms and keywords: Low Level Laser Therapy; Low Level Light Therapy; Low Level Laser Irradiation; Low Level Light Irradiation; LLLT; LLLI; Stem Cells; Bone Marrow; Adipose; Periodontal Ligament; Dental Pulp; Mesenchymal; Cell Proliferation; Cell Differentiation; were used separately and/or in combination to conduct an electronic search in PubMed database for English-language articles published until January 2017. The selection of studies was initiated by the review of articles' titles: eligible papers were characterized as in vitro or in vivo experimental studies that evaluated the use of LLLT on bone marrow (BMSC), adipose (ADSC) or dental (DMSC) stem cells in order to promote their proliferation and/or differentiation. Selected articles had their abstracts analyzed: articles without a case-control design were excluded.

Discussion: From 351 references obtained 25 papers met the search criteria and were included in this review. All reviewed papers showed positive outcomes both for proliferation's and differentiation's rates except for two (Bouvet-Gerbettaz et al. 2009 and Pereira et al. 2012). Eighteen studies (72%) were conducted in vitro and 7 (28%) in vivo. Seven in vitro studies were conducted on BMSC (38,9%), 3 on ADSC (16,7%), 1 on both BMSC and ADSC (5,56%) and 7 on DMSC (38,84%). Four in vivo studies evaluated BMSC (57,15%) and 3 evaluated ADSC (42,85%). All studies measured proliferation's rates, 7 (38,9%) in vitro studies and 4 (57,1%) in vivo studies evaluated differentiation's rates. Sixteen (88,9%) in vitro studies performed LLLT with visible wavelength (range: min 532 nm, max 660 nm) and 2 (11,1%) with near red wavelength (808 nm and 810 nm). Four (57,1%) in vivo studies performed LLLT with visible wavelength (range: min 632.8 nm, max 660nm) and 3 (42,9%) with near red wavelength (range: min 804 nm, max 830 nm). Among all studies 42 different Fluence

setting were used: 18 were between 0.5 and 2 J/cm² (43%), 14 between 2 and 5 J/cm² (33%), 5 between 5 and 10 J/cm² (12%) and 5 with Fluence value higher than 10 J/cm² (12%) (range: min 0.01 J/cm², max 329 J/cm²).

Conclusion: This systematic review showed how LLLT positively influences (both in vitro and in vivo) proliferation and differentiation of stem cells. A lack of uniformity of parameters and evaluation systems was highlighted: grate varieties of wavelengths, power density, power output, time of irradiation, assays and markers were used. However results show that most frequently LLLT was performed with visible wavelength of 660 nm (48%) and Fluence values between 0.5 and 5 J/cm² (76%). This findings could represent a starting point for further investigations with a more defined uniformity in the study's design that would allow a more detailed comparison.

Treatment of medication related osteonecrosis of the jaws: comparison between laser and traditional approaches in a series of 269 cases

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Aim: Osteonecrosis of the jaws is an adverse effect of several medications (medication-related osteonecrosis of the jaws – MRONJ), including bisphosphonates, some monoclonal antibodies and the so-called biologic agents. Different clinical approaches have been proposed to treat MRONJ. The use of Laser (light amplification of stimulated emission of radiation) technologies to improve bone and mucosal healing gives some advantages both for clinician and patients. A non-surgical use of laser, based on the principle of low-level laser therapy (LLLT), seems to have some role in the prevention of necrosis, in reduction of pain and in decreasing of suppuration and superinfection related to necrotic bone presence. LLLT can also be use as adjuvant therapy after surgical removal of necrotic bone. Surgical use of laser (cutting and vaporization of soft and hard tissues) can improve healing mainly because of the absence of temperature increase, antibacterial effect and a more clean surgical area possibly related to a faster and better revascularization. In the present analysis we compared 5 different therapeutic approaches used to treat 269 sites of MRONJ.

Methods: Two-hundred and sixty-nine sites of MRONJ (in 184 females (68,4%) and 85 males (31,6%); mean

age 69 years (min.37, max.88) ; 90 (33,46%) maxillary sites and 179 (66,54%) mandibular; 71 (26,4%) Stage I, 174 (64,68%) Stage II and 24 (8,92%) Stage III) were treated between January 2004 and June 2016 at the Center of Oral Medicine and Laser Surgery of the University of Parma, Italy. Five different therapeutic approaches were compared. Group1: 34 sites of necrosis treated only with medical therapy (amoxicillin + clavulanic acid, 1g every 12 hours and metronidazole 500mg every 12 hours). Group2: 69 sites treated with the same medical protocol in adjunction to LLLT application performed with Nd:YAG laser (1064nm FidelisPlus, Fotona-Slovenia, 1,25W, 15Hz), 1 session a week for 5 weeks. Group3: 16 sites treated with medical therapy and traditional burs surgery. Group4: 45 sites treated with medical therapy, traditional surgery, and 5 sessions of Nd:YAG laser LLLT. Group5: 105 sites treated with medical therapy, Er:YAG Laser surgery (2940nm FidelisPlus, Fotona-Slovenia, 250mJ – 20Hz – VSP – Fluence 50 J/cm²) followed by 5 sessions of Nd:YAG laser LLLT after surgery. For the statistical evaluation two outcomes were considered: clinical improvement from a higher stage to a lower one (Clinical improvement – CI) and clinical regression to Stage 0 (Complete healing – CH). The statistical analysis was performed using the Pearson's chi2 test.

Results: LLLT associated to medical therapy is more effective in inducing clinical improvement when compared to medical therapy alone (p=0.0001) (CI of G1=26,47%, CH of G1=20,59%, CI of G2=68,11%, CH of G2=36,23%). Surgical approaches gives better results than medical therapy (CI of G1+G2=54,36%, CH of G1+G2=31,07%, CI of G3+G4+G5=91,56%, CH of G3+G4+G5=86,14%). Er:YAG laser + LLLT showed the best results in inducing clinical complete healing (p=0.0460) (CI of G5=96,19%, CH of G5=92,38%).

Conclusions: Both outcomes, clinical improvement and clinical complete healing is undoubtedly more frequent in goup where LLLT has been used. Er:YAG Laser surgery appears to be the best therapy for all the stages treated, inducing clinical improvement of all the Stage 3 necrosis, in the present series.

Laser therapy in the treatment of peri-implantitis

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Aim: Peri-implantitis is one of the major causes of concern today regarding dental implant failure. Several surgical and non-surgical treatments have been proposed in cases of peri-implant diseases. Recently, an increasing tendency has urged dentists toward application of laser in the treatment of peri-implant diseases. Aim of the present work is to present a review of the current literature on the effectiveness of laser therapy as an alternative to conventional non-surgical treatments. In particular, the effect of laser on oral mucosa, implant surface and bacteria involved in peri-implant disease was investigated. A comparison of the efficacy of different types of lasers for the treatment of peri-implantitis was carried out as well.

Methods: The data sources used were PubMed and Springer link. Searches of these databases were restricted to English language articles published between 2005 and 2016. Additionally a manual search was conducted via the 'Dulce Chacon' library of the European University of Madrid. All in vitro, in vivo, human clinical trials and trials carried out on sample groups regarding the treatment of peri-implantitis by means laser therapy were included.

Results: 24 publications satisfied the inclusion criteria, with a total of 330 subjects and 977 implants. The types of lasers used were Diodes, Er:YAG, CO₂, Xe-Cl (excimer). Laser therapy demonstrated bacteriostatic and bactericidal effects in three and in eight studies, respectively. The implant surface resulted altered in three studies, and unaltered in four publications. In peri-implantitis lesions non-surgical therapy with laser was found to be effective in eleven studies. The Er-YAG and Diode lasers were proven to be effective in eight and ten studies, respectively. In many studies, a reduction of bleeding on probing index (BoP) were found after both conventional and laser non-surgical treatments of peri-implantitis, confirming the success of the treatments. However, no statistical or clinical differences between the two different approaches were observed. Studies focused on the effects of laser on bacteria confirmed the effectiveness of laser therapy as non-invasive method for reducing the pathogens on implant surfaces and within the periodontal apparatus.

Conclusion: In conclusion, laser technology is to be considered a good treatment option for peri-implant diseases as long as it is used in conjunction with professional hygiene therapies (prophylaxis and curettage), antibiotics or chlorhexidine. Laser shows bactericidal or bacteriostatic effects, in relation to the technique applied. These effects are not relevant on rough areas of implant surfaces and in presence of subgingival calculus. In the mucosa, laser causes decreased bleeding and reduction of pocket depth.

Finally, among the examined lasers, Diode and Er-Yag lasers resulted to be the most effective ones.

The low-level laser therapy in the management of oral mucositis in patients undergoing hematopoietic stem cell transplantation: a pilot study

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Aim: Mucositis is a frequent and debilitating inflammatory complication affecting oropharyngeal mucosa, esophagus and gastro enteric tract in oncological patients treated by radiotherapy and/or chemotherapy. Specifically, Oral Mucositis (OM) occurs in up to 75% of patients receiving high-dose of myeloablative chemotherapy used for conditioning regimens for allogeneic Hematopoietic Stem Cell Transplantation (HSCT). Clinically, OM is characterized by erythema or ulcerative lesions that can lead to several problems, including oral pain, increased risk of secondary infection due to open sores in the mucosa and difficulties in eating, drinking or speaking. In addition, narcotic analgesia and complete parenteral nutrition are commonly required after HSCT. Advantages of low-level laser therapy (LLLT) for OM are well reported in literature as a result of its anti-inflammatory, biomodulator and tissue repair properties. The absence of standardized guidelines about technical parameters (power, dose, wavelength, time of treatment) is the principal limit in the use of LLLT for OM. The aim of this pilot study is to evaluate a LLLT protocol in patients affected by OM undergoing HSCT.

Methods: Twelve patients (mean age 34 years) affected by OM induced by conditioning regimens for HSCT were enrolled in this study at the Policlinic Umberto I of Rome, Department of Cellular Biotechnologies and Hematology. At each visit, daily clinical evaluation of OM was performed using the WHO criteria instead subjective pain was monitored by a Numeric Rating Scale (NRS). In addition, related blood cell counts was recorded. All the patients were irradiated with a double diode laser (Lumix 2®, Prodent, Italy) emitting contemporarily at 650 nm and 910 nm, with a power of 1.0 W and a fluence of 4 J/cm². LLLT started the day after the diagnosis of OM and continued for 9 consecutive days (10 days in total). Laser was applied by a single operator that irradiated the sites of OM in defocused (non-contact) mode, with a scanning movement, about 1cm from the mucosal lesions.

Statistical analysis was realized using the software SPSS® version 22.0. Data, expressed as medians, were analyzed by the non-parametric Wilcoxon test, with $p < 0.05$ considered as statistically significant.

Results: About OM grade, a statistically significant difference was found comparing the difference on day 1 and day 3 (from 3.1 to 2.5; $p = 0.04$) and between the initial and final grade of OM (from 3.1 to 1; $p = 0.02$). Similarly, the difference between the NRS grade on day 1 and day 3 and day 1 and day 10 was statistically significant respectively from grade 8 to 5 ($p = 0.03$) and from grade 8 to 0.5 ($p = 0.01$). Parenteral nutrition was required in two patients; moreover, morphine administration was necessary for ten patients.

Conclusion: Management of OM, since the fragility of patients, is very arduous. Our preliminary results are encouraging because of a good decrease of OM grade and pain in few days; moreover, all the patients agreed the treatment confirming the general good compliance related to laser therapy. Clinical trials, with a larger number of subjects and with a control group, are needed to test our protocol.

Preliminar evaluation of a new surgical laser scalpel

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Aim: The scalpel is an essential instrument in most of surgeon's actions. There is evidence that the surgical knife dates back as to the Mesolithic era and nowadays it continues to be widely used both in general and oral surgery. More than ninety surgical blades and handles meeting specific requirements exists. In 21th century, minimally invasive techniques are evolving supported by modern surgical instruments such as endoscopes, lasers and ultrasound sources. As a result, most of incisions and surgical accesses are diminishing or disappearing. Even though many oral surgical procedures (and surgeons) require the use of traditional carbon stainless steel scalpels, there are many complex microsurgical procedures in which laser could be conveniently used due to their hemostatic capabilities and biological advantages. Recently,

Sapphire tips have been introduced in some surgical systems owing to the excellent optical transmission properties, high resistance, thermal conductivity and heating tolerance of this material. The aim of these study was to evaluate the efficacy of newly introduced handpiece equipped with vary sapphire tips mounted on a 915 nm diode laser in the oral soft tissue surgery.

Methods: Thirty-four patients underwent oral soft tissue surgery sorted as follows: 8 excisions of benign oral lesion (8 histological examinations were performed), 15 implant uncovering and 11 incisions in order to design a mucoperiosteal flap. Data on patients treated in the Oral Surgery Unit through 915 nm Laser with Sapphire Scalpel tips have been collected focusing on intraoperative and postoperative complications, reporting of post-operative pain according to the Numeric Rating Scale (NRS), quality of haemostasis, suture need. Practicality of surgeon in handling the instrument with precision in different clinical situations was registered. Furthermore, histological examinations and morphometrical measurements* were carried out so as to investigate the tissue thermal damage on aforementioned excisional biopsies.

Results: In all patients undisturbed healing was observed (100%). Haemostasis was always adequate (100%), thus no suture were required save those which were used to reposition the mucoperiosteal flaps. In all cases sutures were successfully removed after 5 days and no complications (0%) such as infections, wound dehiscence, intraoperative and postoperative bleeding occurred. Patients reported little pain with an average of 3.1(NRS). The mean histologic tissue damage measured in samples was 651,83 μm .

Conclusion: The combinations between diode laser and sapphire tips allowed surgeon to safely perform precise oral incisions in conjunction with an acceptable degree of thermal tissue damage, satisfactory haemostatic capability and early sutures removal. Thus, sapphire laser scalpel have proved to be and effective, mini-invasive and safe instrument which is easy to use and well-tolerated by patients.

The efficacy of diode laser in laser-assisted periodontal therapy

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Aim: The purpose of this perspective split mouth randomized clinical study is to evaluate the efficacy of diode laser in support of non-surgical periodontal

therapy. The purpose is to demonstrate that laser adjunctive treatment can promote better results than scaling and root planing alone and support better healing.

Methods: Five patients (3M, 2F, age range 44-65) affected by chronic periodontitis were enrolled in the present study. These patients followed a strict, specific non-surgical periodontal protocol for 3 months. Number of evaluated teeth was 136, sixtyseven for the test group and 69 for the control group. Quadrants were equally divided between left and right. Control group (CG) was treated with scaling and root planing (SRP), while patients in test group (LG) received diode laser therapy (Wavelength: 980nm Power:2.5 W; mean 0.7W; 10 Hz Modality: pulsed (pw) ton=30ms, toff=70ms; Fluence: 55,7 J/cm²; Time: 30s/site; Fiber: 0.400mm) in adjunct to SRP. When using laser the periodontal pockets are irrigated with 3% hydrogen peroxide with a single use blunt syringe Clinical parameters recorded at T0 and at T1 (after 3 months) were: clinical attachment loss (CAL), probing pocket depth (PPD) and bleeding on probing (BOP). Statistical analysis was performed using the T student test.

Results: For patients in test group, the mean clinical attachment loss (CAL) recorded at T0 was 3.8mm. At T1, it was reduced to 2.64mm. In control group, CAL at T0 was 3.54 mm and 2.98 mm at T1. Clinical attachment loss reduction was therefore 1.16 mm in the test group and 0.56 mm in the control group ($p < 0.001$). In the test group the mean probing pocket depth (PPD) at T0 was 3.6mm and at T1 it decreased to 2.36 mm. In control group PDD was 3.42 mm at T0 and 2.9 mm at T1. The mean PPD reduction in the test group is 1.24 and 0.52 in the control group ($p < 0.001$). BOP was present in 50% of the sites in the test group at T0 and was reduced to 5% at T1. In the control group, it was 41% at T0 and was reduced to 16% at T1. So the reduction was 45% for the test sites and 25% for the control ($p < 0,001$).

Conclusion: Non-surgical periodontal therapy is proven to provide important benefits to patients affected by periodontal disease. The present study shows adjunctive therapy with diode laser can statistically improve results of SRP. Such a therapy is associated to improvement of all the biometric parameters. All patients in the test group and in the control group did show a satisfactory healing pattern after therapy. However, the results were statistically significantly better patients treated with laser.

Alternative approach in congenital epulis

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Aim: Congenital Epulis, more recently renamed GCT of the newborn, is a rare, benign, granular cell tumor present on the intraoral cavity, with the potential to interfere with respiration and feeding. It is a reactive tumor like lesion which arises in response to various stimuli such as chronic low grade local irritation, traumatic injury, hormonal factors or certain kinds of drugs. The typical appearance is smooth, pedunculated and pink. Epulis is distinguished from other oral soft tissue tumors by its maxillary or mandibular alveolar location (3:1) usually around the canine incisor, its female (8:1) predominance and its solitary nature. Based on its size, documented to be up to 9 cm, this tumor can complicate feeding and respiration. Aim: is to report an alternative approach to remove successfully GCT with diode laser (810 nm) as a conservative and non-stressful method in a pediatric patient.

Methods: Various treatment techniques have been described for GCT. Conservative surgical excision and removal of the causative irritant or source of trauma are the usual treatments. Conventional surgery can be followed by several complications such as intraoperative bleeding, difficulties in wound healing and maintenance of sterility during surgery. The use of lasers in a variety of surgical procedures has been well documented. Diode laser (with wavelengths varying between 800 and 980 nm) is poorly absorbed by hard dental tissue, is safe and well indicated for soft oral tissue surgeries for cutting, vaporization, curettage, blood coagulation, and hemostasis in the oral region. Written informed consent was obtained from the patient's parents for excising the lesion by diode laser. The patient and the whole staff were asked to wear protective glasses. Diode laser (Diode Laser, DMT Lissonne, Italy) at 810 nm wavelength and continuous wave mode with a power output of 3 watt and a 0.4-mm diameter fiber optic was set for excising the lesion. The tip was directed at an angle of 10 to 15 degrees, moving around the base of the lesion with a circular motion. It took 3 minutes to complete the procedure. The diode laser provided an optimum combination of clean cutting of the tissue and hemostasis. The patient was discharged with necessary post-operative instructions for maintenance of good oral hygiene and keeping the area clean. No additional analgesic or antibiotic was recommended. The patient was visited after 2 weeks, 1, 3, 6 and 12 months and the healing process was desirable. No recurrence of the lesion was reported by patient's parents.

Results: Postoperatively, the patient had no signs of respiratory distress or feeding difficulty, and she demonstrated age-appropriate weight gain. The intraoral alveolar wound healed without complication and no signs of infection or mass recurrence were noted. The histopathological examination confirmed the diagnosis of epulis, or granular cell tumor (GCT). One year postoperatively, the patient had a

functionally and developmentally normal alveolar ridge without tumor recurrence and normal dental mandibular arch was present.

Conclusions: Lasers are suitable for soft tissue surgery in current dentistry, especially in relation to pediatric patients due to the rapid and regular wound healing without sutures.