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Gingival hyperplasia treatment using diode laser gingivectomy in a child with cerebral palsy: case report

Gengivectomia com laser de diodo para tratamento de hiperplasia gengival em criança com paralisia cerebral: relato de caso

Gingivectomía con láser de diodo para el tratamiento de la hiperplasia gingival en un niño con parálisis cerebral: reporte de un caso

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Abstract
Gingival hyperplasia is associated with several factors, such as chronic inflammation due to the large accumulation of biofilm and medications including anticonvulsants. The aim of this study is to report a clinical case of a 4-year-old spastic quadriplegic cerebral palsy patient with gingival hyperplasia in the palatal region of the upper teeth induced by the use of high doses of anticonvulsant medications. The patient attended the Dental Assistance Center for People with Disabilities, with fibrotic gingival hyperplasia in the upper posterior region, covering the dental crowns on the palatal and occlusal surfaces. Oral hygiene instructions were previously carried out using chlorhexidine gluconate solution (0.12%) on the teeth with the aid of a cotton swab, twice a day for seven days, to reduce bacterial plaque levels and control periodontal inflammation. Gingivectomy was performed using a gallium aluminum arsenide diode laser (GaAlAs; 808±10 nm, 2.5 W output power, continuous mode). Following the surgical procedures, photobiomodulation therapy was performed with a low-level aluminum gallium indium phosphide diode laser (InGaAlP; 660±10 nm, 100 mW, 3 J) at three points (anterior, middle and posterior region of surgical wound). The patient returned at 7 and 30 days after surgery presenting accelerated wound healing. It was concluded that the high-level diode laser associated with photobiomodulation therapy were effective for performing a conservative and safe procedure in a patient with severe neurological disorder.
Keywords: Diode laser; Gingival hyperplasia; Gingivectomy.

Resumo
A hiperplasia gengival está associada a diversos fatores, como a inflamação, acúmulo de biofilme e uso de medicamentos como anticonvulsivantes. O objetivo é relatar um caso clínico de um paciente com paralisia cerebral quadriplégica espástica

de 4 anos de idade com hiperplasia gengival na região palatina dos dentes superiores devido ao uso de altas doses de medicamentos anticonvulsivantes. O paciente compareceu ao Centro de Assistência Odontológica à Pessoa com Deficiência, com hiperplasia gengival fibrótica na região posterior superior, recobrindo as coroas dentarias nas faces palatinas e oclusais. Previamente foram realizadas instruções de higiene bucal, utilizando solução de digluconato de clorexidina (0,12%) sobre os dentes com auxílio de cotonete duas vezes ao dia durante sete dias para reduzir os níveis de placa bacteriana e controlar a inflamação dos tecidos periodontais. Foi a realizada cirurgia com o uso do laser de diodo de Galio Alumínio Arsênio (GaAlAs; 808±10 nm) com 2,5 W de potência de saída no modo contínuo. Após o término dos procedimentos cirúrgicos foi realizada terapia de Fotobiomodulação com laser de diodo de baixa potência de Indio Gálio Alumínio Fósforo (InGaAlP; 660 ±10 nm, 100 mW, 3 J) em três pontos (região anterior, média e posterior da ferida). O paciente retornou com 7 e 30 dias após a cirurgia apresentando reparo acelerado da ferida. Conclui-se que o laser de diodo de alta potência associado à Terapia de Fotobiomodulação foram efetivos para realização de procedimento conservador e seguro em paciente com desordem neurológica severa.
Palavras-chave: Laser de diodo; Hiperplasia gengival; Gengivectomia.

Resumen
La hiperplasia gingival está asociada a varios factores, como la inflamación, la acumulación de biopelículas y el uso de medicamentos como los anticonvulsivos. El objetivo es reportar un caso clínico de un paciente de 4 años de edad con parálisis cerebral cuadripléjica espástica con hiperplasia gingival en la región palatina de los dientes superiores por el uso de altas dosis de medicamentos anticonvulsivos. El paciente acudió al Centro de Asistencia Dental para Personas con Discapacidad, con hiperplasia gingival fibrótica en la región posterior superior, cubriendo las coronas dentales en las superficies palatina y oclusal. Previamente se realizaron instrucciones de higiene bucal, aplicando solución de gluconato de clorhexidina (0,12%) sobre los dientes con ayuda de un hisopo de algodón dos veces al día durante siete días para reducir los niveles de placa bacteriana y controlar la inflamación de los tejidos periodontales. La cirugía se realizó con un láser de diodo Galio Aluminio Arsénico (GaAlAs; 808 ± 10 nm) con una potencia de salida de 2,5 W en modo continuo. Una vez finalizados los procedimientos quirúrgicos, se realizó terapia de fotobiomodulación con láser de diodo de indio galio aluminio fósforo de baja potencia (InGaAlP; 660 ± 10 nm, 100 mW, 3 J) en tres puntos (región anterior, media y posterior de la herida). El paciente regresó a los 7 y 30 días después de la cirugía con reparación acelerada de la herida. Se concluye que los láseres de diodo de alta potencia asociados a la Terapia de Fotobiomodulación fueron efectivos para realizar un procedimiento conservador y seguro en pacientes con trastornos neurológicos severos.
Palabras clave: Diodo láser; Hiperplasia gingival; Gingivectomía.

1. Introduction

Cerebral palsy (CP) is one of the most prevalent neurological disorders in children (Cans, 2000; Pakula, et al., 2009). It comprises several disorders resulting from a non-progressive brain lesion during its development and affects motor impairment, associated with sensory, cognitive, perceptual, behavioral and/or epileptic disorders (Bax, et al., 2005; Agarwal, et al., 2012; Colver, et al., 2014). These clinical manifestations can change with the maturity of the central nervous system (CNS) (Mutch, et al., 1992; Bhati, et al., 2019). The global incidence of this condition is approximately 2 and 2.5 cases per 1,000 births (Cans, 2000; Colver, et al., 2014).

Children with CP show an increased risk of malnutrition (Campanozzi, et al., 2007; Calis, et al., 2008) and the prevalence of malnutrition is higher in cases with severe impairment (Brooks, et al., 2011; Quitadamo, et al., 2016). This nutritional status deficit has been associated with social, motor, cognitive effects, and can result in cardiac and respiratory dysfunctions (Bell, et al., 2010; Kerac, et al., 2014).

Gingival hyperplasia (GH) is associated with several factors, such as chronic inflammation due to the large accumulation of biofilm, use of high doses of anticonvulsants (phenytoin, phenobarbital, vigabatrin), immunosuppressants (cyclosporin A) and calcium channel inhibitors (amelodipine, verapamil) (Brunet, et al., 2001; Luvizuto, et al., 2012; Priyadharshini, et al., 2014). Anticonvulsant class drugs are used to control seizures in patients with CP. However, they have several side effects, including GH.

A previous study showed that phenytoin used for the treatment of epilepsy induced gingival growth in about 50% of patients (Tan, et al., 2004), although some patients did not present excessive gingival growth. Nevertheless, some authors have reported that the occurrence of GH caused by phenytoin is 40 to 50% (Kimball, 1939; Annegers, 1997; Cláudio, et al., 2021).

GH treatment can be performed through medical evaluation to change or reduce the dose of the drug, associated with dental treatment with basic periodontal therapy such as prophylaxis, oral hygiene instruction, supragingival and subgingival scaling (Lafzi, et al., 2007). When there is no clinical improvement of the condition after conservative periodontal therapy, surgical periodontal treatment should be adopted for an increase in the clinical crown, using the gingivectomy or gingivoplasty techniques. In recurrence cases, it is common to perform surgery more than once in order to control exacerbated growth (Mavrogiannis, et al., 2006; Luvizuto, et al., 2012; Devi, et al., 2013).

High-level diode lasers can be used to perform various soft tissue surgeries including removal of frenun attachment muscles, gingivectomy/gingivoplasty, gingival contour corrections and gingival smile, clinical crown augmentation, proximal wedge, excisional biopsy, among others (De Oliveira Guaré, et al., 2010; Theodoro, et al., 2015; Cobb, 2016). This laser is also absorbed by chromophores such as hemoglobin in soft tissues, promoting hemostasis; thus, it is commonly indicated in soft tissue surgeries that require hemostatic control (De Oliveira Guaré, et al., 2010). The advantage of using this technology is the possibility of performing a more conserved clinical procedure, as it is a minimally invasive surgery, with less bleeding and no need for suture, which reduces surgery time.

Thus, this study aims to report a clinical case of a 4-year-old patient with cerebral palsy with GH in the palatal region of the upper teeth, caused by the continuous use of anticonvulsant drugs, who was submitted to gingivectomy using a high-level diode laser followed by photobiomodulation (PBM) therapy.

2. Case Report

A 4-year-old male child with cerebral palsy was referred to the Dental Assistance Center for People with Disabilities (CAOE, School of Dentistry of Araçatuba, UNESP, Araçatuba, SP, Brazil), with the main complaint of gingival enlargement in the upper posterior region of the oral cavity, covering several dental crowns mainly on the palatal and occlusal surfaces of the upper teeth. The parents also reported bleeding during hygiene and that the gingival enlargement was increasing over time.

During anamnesis, it was found that the patient had a medical diagnosis of spastic quadriplegic cerebral palsy secondary to severe hypoxic-ischemic encephalopathy and secondary epilepsy. The patient had a gastrostomy and tracheostomy tube, did not respond to any stimulus and made continuous use of topiramate, depakene, clonazepam, sodium valproate, tizanidine, miosan, lamotrigine, melatonin, periciazine phenobarbital and arnica (homeopathy). The patient was being followed up on a home care scheme, with routine medical visits every two weeks, bedridden, under speech therapy treatment once a week, motor and respiratory physiotherapy twice a day, occupational therapy once a week and 24-hour nursing assistance.

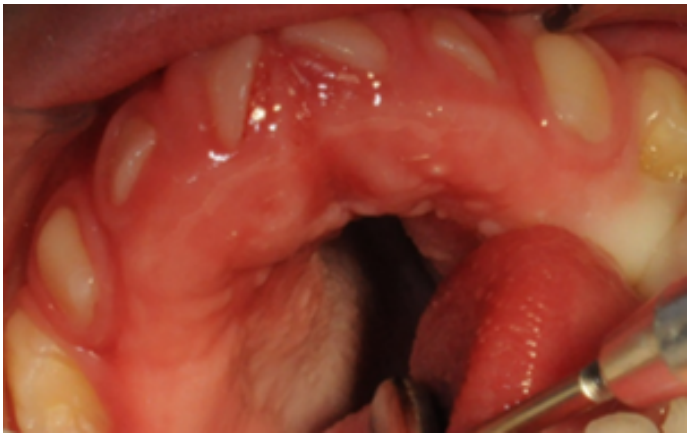
In the intraoral examination of the first visit, anterior open bite, inflammation and fibrotic GH in the palatal region of the upper teeth were observed, with a lobulated appearance, reddish pink color, covering part of the anatomical crown of the dental elements, with the posterior teeth touching the palatine gingival tissue (Figures 1 and 2). The patient had satisfactory

oral hygiene, which was performed by nurses or parents with the aid of gauze and mouthwash. Periodontal examination was performed with a millimeter periodontal probe (PCPUNC-15, Hu-Friedy, Chicago, IL, USA) to assess the amount of gingival growth.

Figure 1 - Preoperative showing gingival hyperplasia in the upper palatine region on both sides, with the posterior teeth touching the palatal gingival tissue.

Source: Authors.

Figure 2 - Preoperative showing fibrotic gingival hyperplasia in the palatal region on the left side.



Source: Authors.

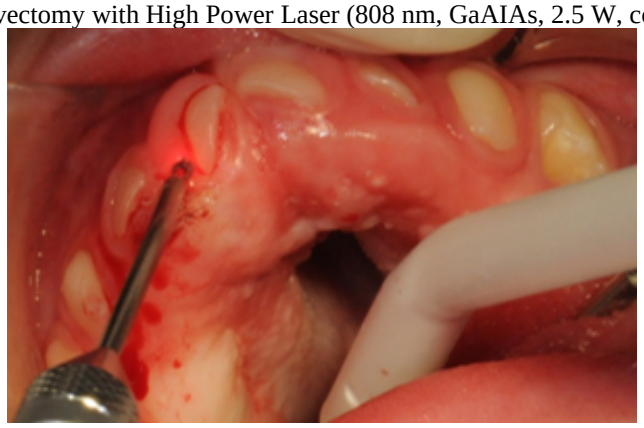
Prior to the dental procedure, a medical evaluation and authorization to perform the surgical treatment on an outpatient basis were requested. The medical report indicated that the patient was not making use of anticoagulant or antiplatelet agent, as well as not presenting secondary or primary immunosuppression. However, the patient presented recurrent pulmonary and urinary tract infections, reporting recent use of antibiotics. As for the dental procedure, according to the medical report, the risk would be similar to that of a child with the same neurological lesion, with no medical contraindication due to systemic conditions. The neurologist evaluated the use of the anticonvulsant medication in an attempt to optimize the treatment, but it was not possible to change the medication or the medication dose.

Surgical treatment

In the first visit, the guardians of the patient were instructed on oral hygiene care, using a solution of chlorhexidine gluconate (0.12%, Periogard, Colgate, Campos, SP, Brazil) on the teeth with the aid of a cotton swab, twice a day for seven days, in order to reduce bacterial plaque levels and to control inflammation of periodontal tissues. In the second visit, gingivectomy was performed using a high-level diode laser (808±10 nm nm, Thera Lase Surgery, DM Equipment's LTDA, São Carlos, SP, Brazil) to reduce bleeding and perform a faster, safer procedure, minimizing postoperative symptoms, as it is a conservative surgery. Initially, the patient was accommodated on an inflatable mattress positioned on the dental chair for better adaptation during the surgical procedure, requiring the use of oxygen therapy in a tracheostomy mask, for comfort and maintenance of the breathing pattern (4L/min). Patient maintained saturation (SpO_2) at 96% and heart rate at 126 bpm. The procedure was started with intraoral antisepsis with chlorhexidine gluconate solution (0.12%) and extraoral antisepsis with chlorhexidine gluconate solution (2% Apothicário, Araçatuba, SP, Brazil), followed by terminal infiltrative anesthesia with prilocaine hydrochloride with felypressin (0.03 Ul/ mL Citocaína, Itapira, SP, Brazil).

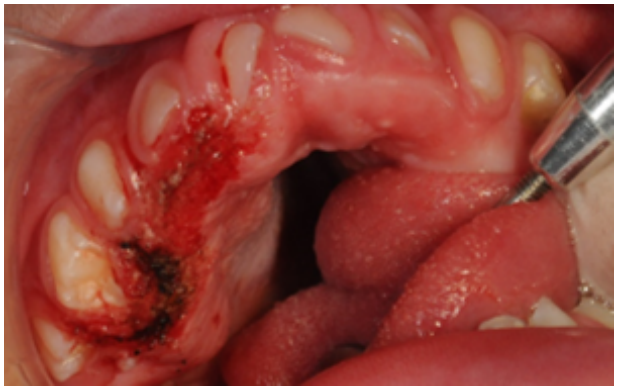
Gingivectomy was performed with a gallium aluminum arsenide diode laser (GaAlAs; 808±10 nm wavelength, Thera Lase Surgery, DM Equipment's LTDA, São Carlos, SP, Brazil) with 2.5 W output power, in continuous mode and using 400 µm diameter fiber. The procedure was performed in two sessions, one quadrant per session for greater safety of the patient's vital signs. In the first session, a gingivectomy was done on the right side and after ten days, the patient returned to assess healing process and perform a gingivectomy on the left side. The laser optical fiber was positioned over the gingival tissue in perpendicular contact with the tissues and the GH was vaporized until the occlusal surfaces were exposed (Figure 3). The procedure was completed conservatively, with minimal bleeding, and hemostasis was controlled only with sterile gauze to aid visualization (Figure 4). During tissue vaporization, a high-powered suction device was used to eliminate the plume formed during the procedure. After completion of the ablation, the back of a Kirkland scalpel was used to thin the edges of the gingival tissue (Figure 5). Immediately after surgery, it was observed efficient removal of the excised tissue, as well as little bleeding of the surgical area, allowing a clean surgery field, thus decreasing the procedure time (Figure 6). This procedure was performed in the first session in the first quadrant on the right side and in the second session in the second quadrant on the left side (Figure 7 and 8).

Figure 3 - Gingivectomy with High Power Laser (808 nm, GaAIAs, 2.5 W, continuous mode).



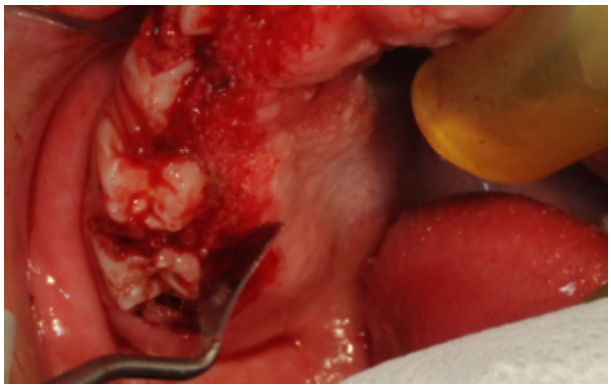
Source: Authors.

Figure 4 - Gingivectomy performed with diodo laser, demonstrating conservative surgery and minimal bleeding.



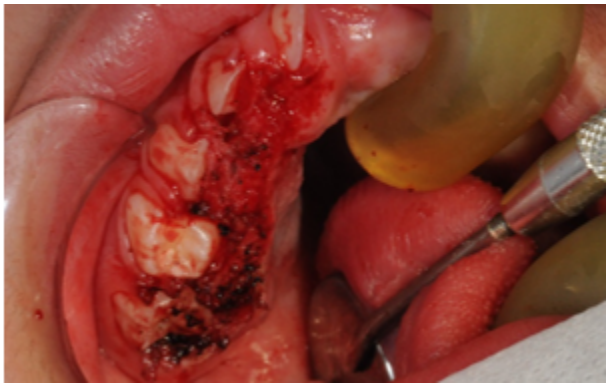
Source: Authors.

Figure 5 - Completion of surgery with the back of a Kirkland scalpel.



Source: Authors.

Figure 6 - Immediate post-operative.



Source: Authors.

Figure 7 – Post-operative right quadrant.

Source: Authors.

Figure 8 - Post-operative left quadrant.

Source: Authors.

Immediately after the end of both surgical procedures, PBM therapy was performed using a low-level indium gallium aluminum phosphorus (InGaAlP) laser (660±10 nm wavelength, 100 mW output power, 3 J energy, 60 seconds per point, 600 µm optical fiber outlet, Therapy XT, DMC Equipment's LTDA, São Carlos, SP, Brazil). The laser was applied at three points (anterior, middle and posterior region of wound) for analgesia and for assisting in the healing process (Figure 9).

Figure 9 - Photobiomodulation therapy with low power diode laser (660nm. InGaAIP; 3J).

Source: Authors.

Due to the presence of intercostal breathing, the procedure was performed with the aid of the index finger positioned in the retromolar trigone region and Molt-type mouth opener. During the procedure, two aspirations were executed in the tracheostomy area because of the presence of secretion.

Revaluation

The patient was reassessed in the periods of ten and thirty days after each surgery (Figure10). It was observed that the patient had excellent tissue repair at 10 and 30 days after surgery in each area, with adequate exposure of the dental crowns, facilitating oral hygiene of the teeth and eliminating occlusal contact of the lower teeth with the palate tissues. The guardians reported that the patient did not present any changes, such as fever, malaise or postoperative restlessness after the surgical procedures. It was noticed at 30 days that the patient maintained good control of bacterial plaque and the use of chlorhexidine for mouthwash was suspended.

Figure 10 - 30 days after surgery.

Source: Authors.

3. Discussion

After analyzing the clinical condition of oral and systemic health of the cerebral palsy patient, the multidisciplinary team verified that the patient had a real need for dental treatment, due to the impossibility of oral closure and difficulty cleaning the dental surface, which was already covered, being a factor of recurrent gingival infection that could influence the immune-inflammatory system. In addition to these facts, the occlusal surface of the lower teeth was traumatizing the palatal region of the gingival tissue, increased in the posterior region by contact, even at rest. The patient was making use of topiramate, sodium valproate and phenobarbital, which are classified as anticonvulsants, some associated with GH development. However, the anticonvulsant action mechanisms that induce GH development are not completely elucidated (Kanno, et al., 2008).

The indication of anticonvulsants began in 1938, to control episodes of epilepsy, cerebral palsy, neuropathic pain and other neurological disorders (Rang, 2012). One year after starting the use of phenytoin, the first article considering gingival enlargement as an adverse effect of the use of this class of medication was published (Kimball, 1939). On the other hand, in a systematic review, the authors concluded that phenytoin is the drug that causes the highest prevalence of GH in

patients who use it (Cláudio, et al., 2021). The pathogenesis of this condition depends on several factors, including the quality of plaque control, gingival inflammation, age, sex, duration of therapy, concentration of drug used, concomitant use of some medications, and genetic factors (Nakib, et al., 2011). Some studies show that the imbalance between synthesis and degradation of collagen fibers can facilitate their accumulation, being the reduction of collagen degradation more likely than its greater production (Salo, et al., 1990; Kato, et al., 2005; Kanno, et al., 2008). Furthermore, studies have found greater severity of GH associated with the use of anticonvulsants in children (Perlik, et al., 1995; Mani, et al., 2001; Tan, et al., 2004; Goyal, et al., 2004). These findings are corroborated by studies showing that the gingival fibroblasts of children exposed to anticonvulsants exhibited higher production of PGE2, TGFβ and IL6, when compared to normal adults (Nazemisalman, et al., 2014; Vahabi, et al., 2014).

For the treatment of GH induced by anticonvulsants, it is recommended to replace the drug or its dosage, associated with dental treatment for plaque control associated or not with surgical treatment. Due to the motor weakness of children with CP, the guidance of oral hygiene by the caregiver is essential, as the accumulation of bacterial plaque associated with the use of this class of drugs further exacerbates the inflammatory process and GH (Trackman, et al., 2015). To facilitate the plaque removal procedure and reduce the inflammatory gingival process, surgical techniques that promote dental exposure should be recommended. Due to the general conditions of patients with special needs, one of the factors to be considered when determining the surgical technique to be adopted is the duration of the procedure. In addition, equipment that optimizes and facilitates its execution must be taken into account. In view of that, the gingivectomy technique with the use of high-level diode lasers becomes an excellent alternative for the treatment of this condition.

Diode lasers are low-cost and portable emitters, which have been commonly adopted in dentistry. Diode lasers have the advantages of being absorbed by hemoglobin, although poorly absorbed by water. In addition, the beam can penetrate up to 10 mm of tissue promoting soft tissue photocoagulation. These characteristics significantly reduce gingival bleeding, as well as promote a safe and efficient gingivectomy procedure. For the incision, the laser is activated and used in continuous contact mode; while for coagulation, it can be used in defocused non-contact mode. These laser characteristics are important and very relevant in the surgical treatment of oral alterations in people with CP, because they shorten intraoperative time as well as reduce the need for aspiration of intra-oral fluids.

Furthermore, as this is a conservative surgery, painful symptoms are minimized by reducing the need for medication, which makes this technique very advantageous, considering that the patient makes continuous use of numerous medications. Finally, due to the ability to promote bacterial reduction, the use of these lasers can also help decrease possible infections in these patients who are immunosuppressed, by declining the number of microorganisms during the surgical procedure in the irradiated area. The surgery using diode laser, in addition to shortening the patient time in the chair by minimizing stress, is more accepted by the patient, as it has other benefits such as reduced bleeding, decreased pain during and after surgery, reduced trauma and no sutures (Gontiya, et al., 2011; Ortega-Concepción, et al., 2017; Khosraviani, et al., 2019).

Devi et al. (2013) reported a case of recurrent idiopathic gingival enlargement after 15 years of anticonvulsant use. Gingivectomy planning was performed with external bevel incisions in both the maxilla and mandible. After 2 weeks, surgery was performed on the lingual and palatal sides using a diode laser (940 nm wavelength, 3W output power in continuous mode) and no recurrence was observed after 1 year of treatment.

In addition to an adequate surgical procedure, good control of bacterial plaque can contribute to lower rates of recurrence of GH after treatment (Günhan, et al., 1995). A previous study showed GH recurrence after 20 months in cases of

poor oral hygiene (Baptista, 2002). Thus, good control of daily oral hygiene and in routine appointments can be a significant factor that delays the GH recurrence (Günhan, et al., 1995; Seki, et al., 2010).

The use of high-level diode laser (810 nm) has the advantages of decreasing the recurrence of gingival growth and better control of hemostasis (Mavrogiannis, et al., 2006). In addition, To et al., (2013), performed a randomized controlled parallel clinical study, where they evaluated the quality of gingivectomy using a diode laser (940 nm wavelength, 1W output power, 300 µm diameter fiber, pulsed mode, 0.05ms duration, 0.2ms intervals) in patients with orthodontic appliance. These authors concluded that laser gingivectomy can contribute to a more favorable improvement in gingival healing, benefiting patients (To, et al., 2013). Similar results were observed in another randomized controlled clinical study, comparing the use of high-level diode laser with the conventional gingivectomy technique (Lione, et al., 2020). They noticed that the use of laser as a treatment had a better result in controlling inflammation, when compared to non-surgical periodontal treatment (Lione, et al., 2020).

In the present clinical case report, the high-level diode laser was used to perform the surgery due to the patient's health condition, as well as to the shortened duration of the surgery with minimal bleeding. In addition, the surgery was assisted by a nurse and a physiotherapist to control the patient's oxygen saturation and vital signs throughout the surgical procedure. Surgery was associated with PBM therapy using a low-level diode laser to accelerate the healing process and reduce edema and postoperative discomfort, considering the patient's systemic conditions and the use of various medications that can interfere with the healing process (Fernandes, et al., 2009; Avci, et al., 2013).

Studies have shown that PBM can increase the metabolic activity of cells, increase their potential for regeneration, angiogenesis and tissue regeneration (Bilhari, et al., 1989; Abergel, et al., 1988). PBM is the application of low power light (Chung, et al., 2012), including the use of light in the non-ionizing spectrum, visible (red), infrared or near infrared (Hamblin, 2017; Tsai, et al., 17). The use of low power light has the ability to stimulate healing, relieve pain, reduce inflammation and produce analgesia (Chung, et al., 2012; Hamblin, et al., 2017; Tsai, et al., 2020).

The effect of PBM therapy using low-level lasers was evaluated in a split-mouth study, after gingivectomy or gingivoplasty surgery on at least six teeth. The experimental group that received PBM therapy immediately after completion of the surgical procedure demonstrated complete healing of the gingival tissues between days 18 and 2, and between days 19 and 24 for the control group (Ozcelik, et al., 2008).

In the present case report, it was observed that diode laser surgery (808 nm) associated with PBM therapy with a low-level laser (660 nm) proved to be efficient in removing GH in children with spastic quadriplegic CP, due to greater safety and efficiency in the trans-operative period, improvement of the clinical condition and gingival tissue healing acceleration.

4. Conclusion

It was concluded in this clinical case report that the use of high-level diode laser gingivectomy followed by PBM therapy promoted intraoperative advantages, such as reduced bleeding and surgical time, in addition to accelerating tissue healing in CP patients, although recurrence cannot be predicted.

Declaration of patient consent

The authors declare that they have gathered all necessary patient consent forms, demonstrating their full authorization for the use of their images.

Conflict of interest

The authors have no proprietary, financial, or the personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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