Arch Health Invest (2025)14(12):2701-2710
http://doi.org/10.21270/archi.v14i12.6712

Clinical Case

Multidisciplinary Management of Diastema Closure with Diode Laser Frenectomy, Photobiomodulation, and Composite Resin: a Clinical Case Report

Manejo Multidisciplinar do Fechamento de Diastema com Frenectomia a Laser de Diodo, Fotobiomodulação e Resina Composta: Relato de Caso Clínico

Manejo Multidisciplinario del Cierre de Diastema Mediante Frenectomía con Láser de Diodo, Fotobiomodulación y Resina Compuesta: Informe de un Caso Clínico

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Abstract
Hypertrophic labial frenulum is characterized by the permanence of gingival fibers connected to the incisive papilla or maintained in a low attachment, which may lead to the development of na interincisive diastema. In most cases, this condition representes an aesthetic and/or functional concern for the patient. This manuscript aims to present a case report of diastema closure using direct restorative techniques after upper labial frenectomy with a high-power laser, followed by photobiomodulation. A 42-year-old female patient complained of the space between her upper central incisors and reported having undergone orthodontic treatment twice. After a thorough medical history and clinical examination, it was decided to perform a labial frenectomy with a high-power diode laser (808 nm, 1.5 W, 20 Hz) to correct the hypertrophic labial frenulum. followed by low-power laser (660 nm, 6 J, 100 mW, 60 seconds) for photobiomodulation, with the aim of reducing trans and postoperative pain. Weeks after the procedure, with the surgical area completely healed, the diastema was closed using composite resins. It can be concluded that an excellent functional and aesthetic result was achieved, exceeding the patient's expectations, with an improvement in her self-esteem and social interaction.
Descriptors: Diastema; Lasers; Labial Frenum; Oral Frenectomy; Case Reports.

Resumo
A hipertrofia do frênulo labial caracteriza-se pela permanência de fibras gengivais aderidas à papila incisiva ou mantidas em inserção baixa, o que pode levar ao desenvolvimento de um diastema interincisivo. Na maioria dos casos, essa condição representa uma preocupação estética e/ou funcional para o paciente. Este artigo tem como objetivo apresentar um relato de caso de fechamento de diastema utilizando técnicas restauradoras diretas após frenectomia labial superior com laser de alta potência, seguida de fotobiomodulação. Uma paciente de 42 anos queixava-se de espaço entre os incisivos centrais superiores e relatou ter realizado tratamento ortodôntico duas vezes. Após anamnese e exame clínico completos, optou-se por realizar frenectomia labial com laser de diodo de alta potência (808 nm, 1,5 W, 20 Hz) para correção da hipertrofia do frênulo labial. Seguiu-se a aplicação de laser de baixa potência (660 nm, 6 J, 100 mW, 60 segundos) para fotobiomodulação, com o objetivo de reduzir a dor transoperatória e pós-operatória. Semanas após o procedimento, com a área cirúrgica completamente cicatrizada, o diastema foi fechado com resina composta. Conclui-se que foi obtido um excelente resultado funcional e estético, superando as expectativas da paciente, com melhora em sua autoestima e interação social.
Descritores: Diastema; Lasers; Freio Labial; Frenectomia Oral; Relatos de Casos.

Resumen
El frenillo labial hipertrófico se caracteriza por la persistencia de fibras gingivales conectadas a la papila incisiva o mantenidas en una inserción baja, lo que puede ocasionar la formación de un diastema interincisivo. En la mayoría de los casos, esta condición representa una preocupación estética y/o funcional para el paciente. Este manuscrito presenta un caso clínico de cierre de diastema mediante técnicas restauradoras directas tras una frenectomía labial superior con láser de alta potencia, seguida de fotobiomodulación. Una paciente de 42 años consultó por la presencia de espacio entre sus incisivos centrales superiores y refirió haber recibido tratamiento de ortodoncia en dos ocasiones. Tras una anamnesis completa y una exploración clínica, se decidió realizar una frenectomía labial con láser de diodo de alta potencia (808 nm, 1,5 W, 20 Hz) para corregir el frenillo labial hipertrófico, seguida de fotobiomodulación con láser de baja potencia (660 nm, 6 J, 100 mW, 60 segundos), con el objetivo de reducir el dolor transoperatorio y postoperatorio. Semanas después de la intervención, una vez cicatrizada por completo la zona quirúrgica, se cerró el diastema con resinas compuestas. Se puede concluir que se logró un excelente resultado funcional y estético, superando las expectativas de la paciente, con una mejora en su autoestima e interacción social.
Descriptores: Diastema; Lasers; Labial Frenum; Oral Frenectomy; Case Reports.

INTRODUCTION

The labial frenulum is a fold of mucous membrane, usually triangular in shape and composed of fibrous connective tissue that connects the lips, which are mobile structures, to the gums or alveolar mucosa, structures fixed to the maxilla; it is usually located in the midline, between the central incisors[1,2]. Its development begins in the third month of pregnancy with its base facing the apical part of the alveolar process, so that at birth, it may be inserted on the palatine papilla. Among the types of insertions, the most common are mucosal and gingival fixation, while those classified as papillary and penetrating papillary are the least common[1,3,4].

Among the complications that this developmental anomaly can cause are restricted lip movement, difficulty with hygiene, food impaction, gum recession, periodontal pocket formation, prosthetic problems, compromised orthodontic treatment, difficulties with breastfeeding, interference with speech and aesthetics, and formation of interincisal diastema,[2,5,10] in which the latter, when associated with hypertrophic labial frenulum, cannot be solved with orthodontic treatment alone, which may cause its recurrence and the persistence of phonation and aesthetic problems.

Therefore, labial frenectomy surgery is an excellent option for correcting this developmental anomaly, which involves removing the entire labial frenulum, from its mucosa to the fibers that connect it to the bone adjacent to the labial mucosa[1,2,9,11], contributing to the prevention of diastema recurrence, reducing tension in the gingival tissues, promoting their stability, restoring the patient's anatomy, aesthetics, and phonation, and preventing future periodontal problems[9,11,12]. The conventional surgical technique is performed using a manual scalpel through Z-plasty or V-Y flap techniques.[5]. However, good pain control is necessary during surgery, which already brings with it some complications, such as difficulty in patient adherence to treatment, as well as more significant bleeding and postoperative pain. Thus, the use of lasers in dentistry has become a very promising alternative to solve the problems caused by the use of conventional techniques[1,5,12,13].

Lasers can be classified into two types: high-power lasers, used in periodontal surgery on soft and hard tissues, and low-power lasers, used for photobiomodulation of the area undergoing surgery. Among high-power lasers, there are a variety, such as Nd:YAG, Er:YAG, Er,Cr:YSGG, carbon dioxide laser, and high-power diode laser[1,12,13]. The benefits offered by the use of high-power lasers include improved agility, reduced operating time, and precision, since lasers have a greater affinity for soft tissues; less surgical damage; less bleeding, ensuring better visualization of the surgical field by the operator; no need for sutures; reduced dose of local anesthetic, as the procedure results in reduced pain, ensuring better recovery for the patient, without complications and rapid functional rehabilitation of the stomatognathic system in the first postoperative week[1,5,12,14,15]. The patient's rapid recovery can be ensured with the use of low-power lasers, which, through tissue photobiomodulation, aim to reduce tissue inflammation and accelerate the repair process of surgical wounds, in addition to reducing the patient's sensitivity to pain[13].

However, interincisal diastemas, recently classified as malocclusion, may remain in the patient even after repeated surgeries or orthodontic treatments. However, since in most cases they are a source of aesthetic dissatisfaction, compromising dentofacial harmony, phonation, and causing functional and psychological discomfort for patients, it is necessary to apply direct or indirect restorative techniques, such as the use of direct composite resin to close the diastemas[16,19].

This technique enables satisfactory aesthetic results, recreating the natural characteristics of a tooth, restoring its function, and reestablishing the biomimetic properties of color, translucency, and opacity, while also providing excellent adhesion to dental substrates. It is capable of correcting discrepancies in the size and shape of dental elements, bringing very satisfactory results, in addition to the possibility of performing the procedure in a single session, without wearing down the dental structure, contributing to the principles of minimally invasive dentistry[18,19]. The objective of this article is to report a clinical case of a patient with high sensitivity to pain and hypertrophic labial frenulum, who underwent labial frenectomy surgery with a high-power diode laser, followed by photobiomodulation and diastema closure with composite resin.

MATERIAL AND METHOD

This manuscript adhered to the CARE guidelines[20] and presentes a descriptive qualitative case report based on determining the characteristics, etiology, and treatment of diastema closure, as well as the resolution of hypertrophic upper labial frenulum in a 42-year-old female patient who presented with hypertrophic labial frenulum and, as a consequence, a diastema between the upper central incisors. The patient reported high sensitivity to pain, dental phobia, and had undergone orthodontic treatment twice in her life in an attempt to resolve the case, but without success. Therefore, she attended the undergraduate Dentistry clinic and was eventually referred to the Periodontics clinic (undergraduate)

at the Araçatuba School of Dentistry – UNESP. The patient signed the informed consent form provided by the Araçatuba School of Dentistry – UNESP authorizing the diagnosis, treatment, and use of images for publication in scientific journals or magazines, in accordance with the Declaration of Helsinki[21].

CASE REPORT

A 42-year-old health-female patient was being treated at the Dentistry Clinic of the Araçatuba School of Dentistry (FOA-UNESP) and reported being unhappy with the space between her anterior teeth in the midline region of the maxilla. At the first consultation, after clinical examinations and a complete evaluation of the patient, the presence of a hypertrophic labial frenulum was found, extending from the upper labial mucosa to near the cervical region of the upper central incisors. Intraoral and extraoral photographs were then taken of the initial state of the patient's smile (Figures 1, 2 and 3).

After initial records were taken and a thorough clinical examination of the patient was performed, upper lip frenectomy was suggested, as she reported recurrence of interincisive diastema, even after two previous orthodontic treatments. However, because she did not want to remain in complete rest for days, was a patient with dental phobia, had previous reports of high sensitivity to pain, and did not want to undergo a very invasive procedure, we opted for a treatment plan that included less invasive surgery. Lip frenectomy surgery was performed with a high-intensity diode laser (808 nanometers (nm); 1.5 Watts) with 600-micrometer fiber optics after the patient denied any type of comorbidity. Immediately after vaporization, photobiomodulation therapy was performed at the site of the surgery with a low-power laser (660 nm; 6 joules (J); 60 seconds; 214 J/cm²). Photographic records of the immediate postoperative period were then taken.

It was proposed to the patient that after the surgery, we would follow the treatment plan for closing the diastema using minimally invasive restorative techniques, with the use of composite resin, as it is low cost, can be done in at least one session, is easy to maintain, and is highly aesthetic, recreating the natural characteristics of the tooth and meeting all the patient's requirements. The width of tooth 11 and the anatomy of the mesial, vestibular, and palatal surfaces of teeth 11 and 21 were restored in order to eliminate the space between the teeth, called “black space.” The patient agreed and trusted our treatment plan, giving us her approval to continue the work.

Initially, the patient was referred to the undergraduate clinic in the Periodontics department, where she was properly received and accommodated.

Figure 1: Preoperative clinical examination: initial clinical appearance of the patient, without lip separation.

Figure 2: Preoperative clinical examination: clinical appearance of the patient, with lip separation.

Figure 3: Preoperative clinical examination: clinical appearance of the patient, with lip separation.

Then, after performing a follow-up clinical examination and measuring blood pressure, which was within normal limits, we began by performing intraoral antisepsis with 0.12% chlorhexidine solution, in which the patient rinsed her mouth for 1 minute, and extraoral antisepsis with 10% povidone-iodine (PVPI). Next, the patient was anesthetized locally, first with the application of a topical anesthetic on the upper labial frenulum region, followed by subcutaneous infiltrative anesthesia on the frenulum region with a 2% mepivacaine anesthetic solution combined with 1:100,000 adrenaline (Figure 4). With the patient under local anesthesia, upper lip frenectomy surgery started by clamping the upper lip frenulum with curved hemostatic forceps and vaporizing the mucosa and sectioning the gingival fibers with a high-power laser (808 nm; 1.5 Watts) with a 600-micrometer fiber optic (Figure 5).

Figure 4: Labial laser frenectomy and photobiomodulation.: Clamping and local anesthesia of the upper labial frenulum.

Figure 5: Labial laser frenectomy and photobiomodulation.: Clamping and local anesthesia of the upper labial frenulum: Ablation of the mucosa and sectioning of the gingival fibers of the upper labial frenulum with a high-power laser.

Next, photobiomodulation therapy was performed on the ablated tissue using low-power laser irradiation with a wavelength of 660 nm, 10 mW of power, 6 J of energy, for 60 seconds (214 J/cm²), to accelerate the healing process, modulate the inflammatory process, and reduce postoperative pain symptoms (Figures 6 and 7).

Photographic records were taken immediately after surgery (Figures 8 and 9), and the patient was prescribed only analgesics (one pack of dipyrone monosodium (500 milligrams)) for postoperative pain relief, if necessary.

Figure 6: Labial laser frenectomy and photobiomodulation.: Photobiomodulation therapy on the area of labial and gingival mucosa undergoing surgery.

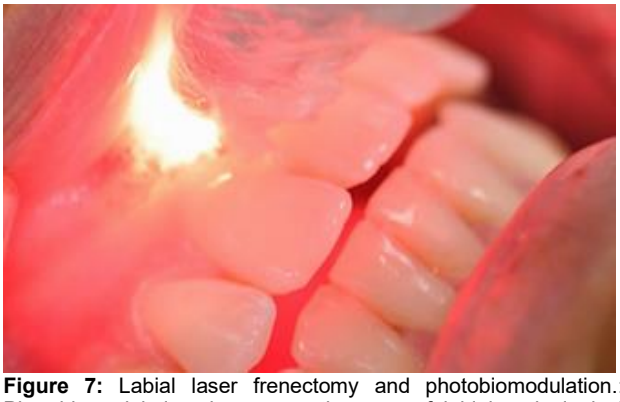

Figure 7: Labial laser frenectomy and photobiomodulation.: Photobiomodulation therapy on the area of labial and gingival mucosa undergoing surgery.

Figure 8: Photographic record of the immediate postoperative period, with the fibers already sectioned and the mucosa cauterized.

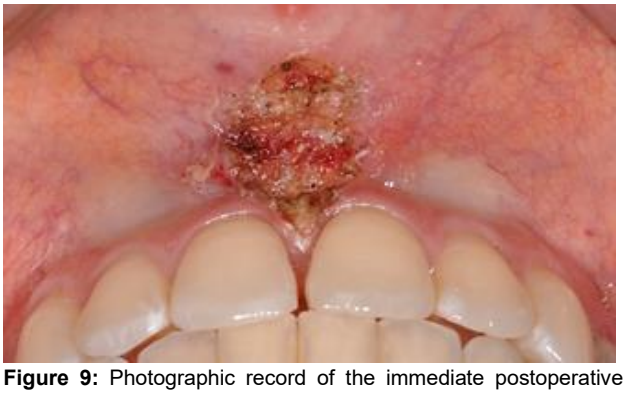

Figure 9: Photographic record of the immediate postoperative period, with the fibers already sectioned and the mucosa cauterized.

During the postoperative period, the patient reported feeling only slight discomfort on the first day, requiring only one analgesic tablet to relieve pain symptoms, demonstrating that the use of lasers in dentistry is a very effective alternative for performing surgeries, especially for odontophobic patients and those with high sensitivity to pain. Photographs were taken on days 7, 21, and 27 after surgery (Figures 10, 11, 12, 13 and 14), recording the patient's healing and improved recovery when using this technique.

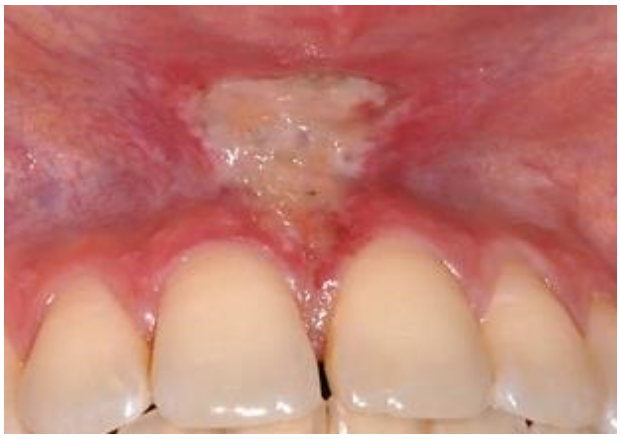

Figure 10: Postoperative period: postoperative record at 7 days, initial epithelialization, with a thin layer of fibrin.

Figure 11: Postoperative period: postoperative record at 7 days, initial epithelialization, with a thin layer of fibrin.

Figure 12: Postoperative period: postoperative at 21 days, partially regenerated epithelium, erythematous in color.

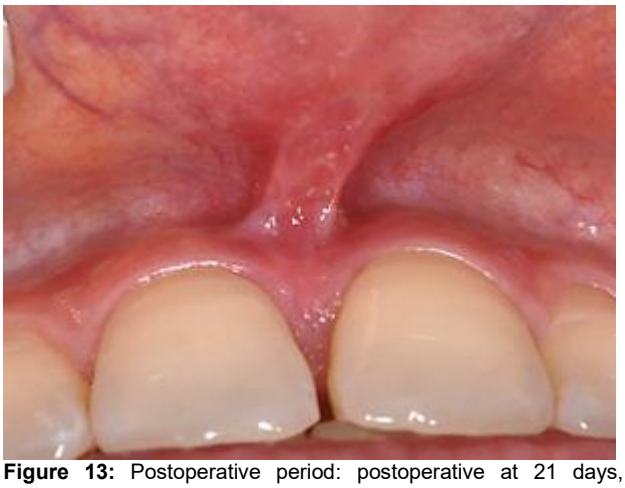

Figure 13: Postoperative period: postoperative at 21 days, partially regenerated epithelium, erythematous in color.

Figure 14: Postoperative period: postoperative at 27 days, completely regenerated epithelium, normal mucosal color, characterizing clinically healthy gingiva.

After a period of thirty-four days, during which the patient's healing was complete, we began minimally invasive restorative treatment to close the diastema, which was her main complaint.

First, we took photographs of the patient's initial condition (Figures 15 and 16), followed by prophylaxis of the tooth surface with a mixture of pumice and water and a Robinson brush attached to a micromotor, in a clockwise direction.

Figure 15: Initial record of diastema closure.

Figure 16: Record prior to minimally invasive restorative treatment.

Immediately after washing and drying the teeth, the region from the upper canine to the upper canine was completely isolated with a rubber sheet (Madeitex, São Paulo, São Paulo, Brazil) attached to the Young Arch, with ties on teeth 12, 11, 21, and 22, and a rubber stop on the distal of 13 and 23 (Figure 17). Then, the region was conditioned with 37% phosphoric acid for 30 seconds, followed by washing with water and drying with an air jet (Figure 18). For optimal and uniform conditioning of the region, wooden wedges and polyester matrix tape (Kdent, TDV Dental, Pomerode, Santa Catarina, Brazil) were then installed between the central incisors. The adhesive system was applied to the entire conditioned surface with Single Bond Universal adhesive (3M ESPE, 3M do Brasil, Sumaré, São Paulo, Brazil). The application was performed by depositing a drop on the tip of the disposable applicator (KG brush) and actively rubbing it for 20 seconds on all sides of element 11, initially, followed by volatilization of the solvent with an air jet for 10 seconds and then photoactivation of the adhesive with LED (Light Emitting Diode) light with an irradiance of 1000 Mw/cm2, wavelength of 440–490 nm (Led D, Gnatus, São Paulo, Brazil) (Figures 19 and 20). To close the diastema, Tetric N-Ceram composite resin (Ivoclar, Barueri, São Paulo, Brazil), enamel color A2, was initially applied to element 11 with the aid of composite resin insertion spatulas 3078 and SF ½ (Millenium, Golgran, São Paulo, Brazil), both on the buccal and palatal surfaces, protected by polyester matrix tape (Figure 21). After light curing, the resin was applied to tooth 21 (Figures 22 and 23).

Figure 17: Isolation and conditioning of the surface: absolute isolation and installation of ligatures.

Figure 18: Isolation and conditioning of the surface: surface conditioning with 37% phosphoric acid.

Figure 19: Isolation and conditioning of the surface: representative photo of the installation of the polyester strip, wooden wedge, and single application of the adhesive system on element 11;

Figure 20: Isolation and conditioning of the surface: representative photo of the photoactivation of the adhesive system with a light-curing unit on the buccal and palatal surfaces.

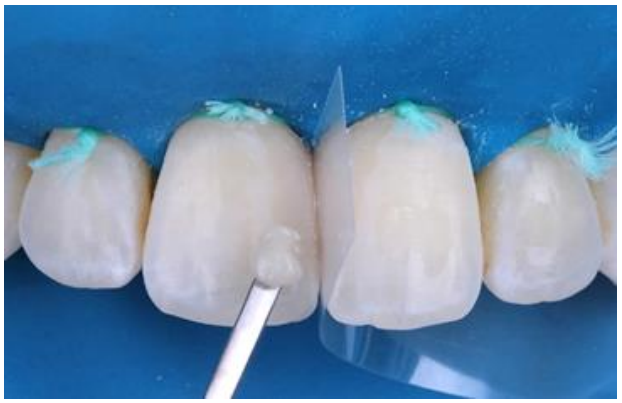

Figure 21: Insertion of composite resin: insertion of composite resin on the vestibular surface of element 11, protected by polyester tape.

Figure 22: Insertion of composite resin: insertion of composite resin on the palatal surface of element 21, protected by polyester tape.

Figure 23: Insertion of composite resin: Appearance of dental elements after insertion of composite resin, final light curing, and with polyester matrix tape.

After final light curing and removal of the polyester matrix tape (Figure 24), initial finishing of the buccal surfaces was performed with the 1190F conical diamond tip (American Burrs, Santa Catarina, Brazil) coupled with high rotation (Figure 25), while the flame-shaped 3118F diamond tip (American Burrs, Santa Catarina, Brazil) was used on the palatal surface.

Figure 24: Finishing and polishing: final appearance after insertion of composite resin without polyester matrix strip.

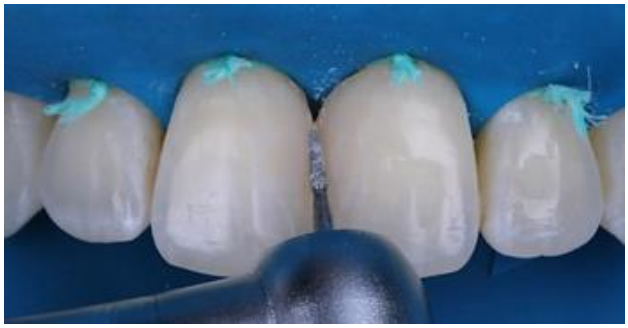

Figure 25: Finishing and polishing: finishing of the buccal surfaces with 1190F diamond tip.

To finish the interproximal surfaces, the absolute isolation was then removed and the 3M ESPE SofLex polyester sanding strip in an “S” shape was used to preserve the contact point (Figure 26).

The resin polishing step was performed with Azdent sanding discs, from coarse to fine grit, to smooth the vestibular surface (Figure 27).

Next, the American Burrs polishing kit was used, initially with flame-shaped abrasive rubbers ranging from coarse to fine grit (Figure 28) and CA Twist Gloss Spiral diamond spirals (American Burrs) ranging from coarse to fine grit (Figure 29).

Finally, to achieve the final shine and polish, the Ultra-Brush goat hair brush (American Burrs) was used in combination with Diamond Polish Mint polishing paste (Ultradent, Indaiatuba, São Paulo, Brazil) on all surfaces of the teeth.

At the end of the procedure, a photograph of the patient's smile was taken (Figures 30 and 31).

Figure 26: Finishing and polishing: interproximal finishing with S-shaped polyester sanding strip.

Figure 27: Finishing and polishing: leveling and initial polishing with Azdent sanding discs.

Figure 28: Finishing and polishing: polishing with flame-treated abrasive rubbers.

Figure 29: Finishing and polishing: polishing with diamond spirals.

Figure 30: Final appearance of the patient's smile after diastema closure with a minimally invasive restorative technique.

Figure 31: Final appearance of the patient's smile after diastema closure with a minimally invasive restorative technique.

DISCUSSION

As observed and reported, each surgical method has its own benefits and limitations. Nevertheless, the main focus of these techniques is to relieve the tension exerted on the marginal periodontal tissues, ensuring the complete removal of the frenulum's attachment to the adjacent bone, promoting better aesthetics and function for the individual.

Given this variety of approaches, the treatment of abnormally inserted labial frenula has been frequently discussed in the literature, highlighting the use of different surgical methods of frenectomy[22-30].

Yadav, et al.[27] conducted a comparative study between two treatment modalities: the use of a conventional scalpel and an Nd:YAG laser. The group treated with laser presented, through the Visual Analogue Scale (VAS), lower pain scores and required fewer analgesics compared to the cold scalpel group. This indicates that the group of patients undergoing laser surgery experienced less pain, both during the procedure and in the postoperative period. The reduction in pain sensation may be associated with the process of protein coagulation in the wound area, which forms a natural barrier. This layer acts as a biological dressing, protecting the nerve endings and, consequently, reducing the painful stimulus. In addition, the same study observed that the use of a scalpel resulted in a more extensive surgical site, with greater blood loss and the need for wider sutures.

Xie et al.[28] conducted a randomized study with 34 patients aged 5 to 10 years who required frenectomy. Participants were divided into two groups: “A” treated with Er:YAG and Nd:YAG lasers, and “B” treated with a conventional scalpel. The comparison considered factors such as surgical time, pain (assessed by the Visual Analog Scale), and complications (difficulties in speaking and chewing) on days 1 and 7 postoperatively. After 3 months, healing was recorded by photographs. The results of the study showed that, although the conventional scalpel is the first choice and easy to use, it caused bruising that interfered with healing, impairing speech and chewing. Another point observed was that the sutures necessary for hemostasis were more difficult to clean, which favored the accumulation of bacterial plaque. In the same study, lasers were used for a comparative analysis, and one of the benefits observed was reduced inflammation, since no sutures were necessary. Nd:YAG and Er:YAG lasers demonstrated the ability to disinfect the surgical site, which further contributes to efficient patient recovery in the postoperative period.

Sobouti et al.[25] highlighted the advantages of using a diode laser in lip frenectomy prior to orthodontic correction, noting less bleeding, reduced or no pain, swelling, discomfort, and no need for analgesics, as well as less or no need for sutures and more efficient healing, results corroborated by the clinical case. The diode laser used in the study proved to be easy to handle, provided effective hemostasis, and eliminated the need for sutures or analgesics. In our clinical case, we observed similar results, with an efficient and fast technique, without bleeding, and with minimal discomfort for patients, both during and after surgery. In addition, healing was excellent, with the surgical site completely healed in four weeks, demonstrating that the use of lasers in dentistry is a very effective alternative for performing surgeries, especially for odontophobic patients with high sensitivity to pain. The combination of frenectomy and photobiomodulation therapy resulted in an excellent aesthetic and functional outcome, exceeding the patient's expectations and improving her self-esteem and social life.

There has also been an increase in patients seeking a more aesthetic smile at dental offices, in line with standards of shape, position, and improvement in tooth color. Problems related to unsightly standards can be solved more effectively through restorative techniques with direct application of composite resin, especially in cases of small diastemas, compared to the use of indirect techniques[19]. Indirect restorations, although they use more resistant ceramic models, require additional wear of the dental tissue for their application, in addition to having a higher cost. In contrast, direct restorations with composite resin are more conservative, as they preserve more tooth structure. In addition, thanks to the variety of

colors and specific types of resins available, when applied properly, they provide a highly satisfactory aesthetic result, very close to naturalness, combined with excellent cost-effectiveness[18,19].

Composite resin is considered a conservative restorative treatment because it does not require excessive or additional wear on the tooth, which corroborates the fact that it has a more efficient and resistant adhesion to enamel than to dentin.[18,19]. To apply it to the enamel, it is necessary to use an adhesive system after conditioning the surface with phosphoric acid (between 32% and 40%), which ensures a stronger micromechanical bond to the enamel compared to dentin.[19] This technique was chosen for this case because it is conservative and minimally invasive, avoiding post-operative pain, such as tooth sensitivity. In addition, composite resin restorations, when properly performed, are resistant, durable, and can last for several years, thanks to their hardness, mechanical resistance to wear, and modulus of elasticity, combined with good polishing[18].

Therefore, choosing a quality resin is essential to replicate the complexity of the shape, color, hue, shine, and polish of the tooth surface, ensuring an aesthetic and natural restoration. For this reason, nanohybrid resins were chosen, which stand out for their excellent polishability and ability to reproduce characteristics such as color, hue, and chroma in a manner very close to the natural appearance of teeth. In addition, this technique offers a highly aesthetic, conservative, and natural result for the patient's smile, combined with excellent cost-effectiveness[19].

CONCLUSION

The techniques applied in this study for the correction of hypertrophic frenulum were effective, the proposed objectives were fully achieved, with good recovery and reduction of postoperative discomfort, meeting the requirements proposed by the patient. With regard to the closure of the diastema, performed using a minimally invasive restorative technique with composite resin, a highly satisfactory aesthetic and functional result was achieved, in addition to excellent cost-effectiveness, meeting all the prerequisites offered to the patient. This integrated approach proved to be an efficient strategy for treating the functional and aesthetic limitations associated with the labial frenulum and diastema, providing the patient with a significant improvement in her quality of life, enhanced by her proud satisfaction and self-esteem.

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CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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Received 13/11/2025
Accepted 18/12/2025