

Treatment of frenectomies with laser optimization

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Abstract— Phrenectomy is the surgical procedure that aims to remove the labial, lingual and bridle curbs, allowing both orthodontic movement to close diastemas, as well as the proper movement of the tongue, necessary for functional activities. There are two techniques for frenectomy. One is the conventional technique with scalpels and periodontal knives, and the other using soft tissue laser. The aim of the study was to conduct a literature review of labial and lingual frenectomies using the laser. The methodology adopted was a literature review, with research of the articles being carried out in the Scielo and LILACS databases, with the descriptors "frenectomy", "frenulotomy" and laser as well as their respective ones in English. From this review, it is possible to observe that laser technology has been considered an alternative to conventional techniques, presenting several advantages such as: shorter operative work time, cauterization and sterilization of tissues, hemostasis, less need for local anesthesia and fewer post-operative complications (pain, edema and infection).

Keywords— Laser. Frenectomy, Lip curl, Frenulotomy.

I. INTRODUCTION

Ankyloglossia is a congenital condition in which a newborn is born with an abnormally short, thickened or tight lingual frenulum that restricts the mobility of the tongue. Ankyloglossia may be associated with other craniofacial abnormalities, but it is also often an isolated anomaly (FERREIRA et al., 2018; GARROCHO-RANGEL et al., 2019).

It variably causes reduced anterior tongue mobility and has been associated with functional limitations in breastfeeding, swallowing, articulation, orthodontic problems, including malocclusion, open bite and separation of lower incisors, mechanical problems related to oral clearance and psychological stress (OLIVEIRA et al., 2019; SOUZA et al., 2015).

Reported rates of ankyloglossia range from 0.1 to 10.7 percent, but definitive incidence and prevalence statistics are difficult to obtain because there are standard or clinically practical diagnostic criteria. An increased prevalence has been reported in newborns with a history of maternal cocaine abuse (SILVA et al., 2018).

Different diagnostic classifications based on anatomy and functional criteria have been proposed for the condition, but none have been universally accepted. The management of ankyloglossia in children is generally multidisciplinary, involving the participation of specialists in pediatric dentistry, periodontics, oral surgery, otolaryngology, and speech therapy, among others (OLIVEIRA et al., 2019).

It has been accepted worldwide that lingual frenectomy (frenulectomy, frenotomy, frenuloplasty) is the best approach to resolve the associated inconveniences of ankyloglossia. The procedure consists of the surgical release of the abnormal frenulum to release the movements of the tongue (COTA et al., 2019).

Various surgical techniques have been proposed, such as simple cutting with slides in newborns (also known as frenotomy), z-frenuloplasty, electrocauterization (argon plasma, monopolar bipolar diathermy), cryosurgery and lasers.

Laser is defined as electromagnetic and monochromatic radiation propagated at various

wavelengths. Lasers provide an energy concentration in the form of an intense beam of light, in the infrared (IR) and ultraviolet (UV) spectral bands that can be used in oral soft tissue surgery. They can be classified as low or high intensity lasers (CARDOSO et al., 2016).

Since the first studies in the 1960s and 1970s, fractional CO₂ or Erbium laser, neodymium and diode have been widely used for excision of soft tissues in pediatric maxillofacial lesions due to their reliability, versatility, practicality and simple configuration. In addition, this treatment option has demonstrated several therapeutic properties, including anti-inflammatories, biostimulants and satisfactory post-operative regenerative effects, improving and accelerating wound healing (PINHEIRO et al., 2018; RIBEIRO; SILVA, 2019).

With children, laser surgery offers additional advantages, including reduced operating time, minimal amounts of anesthesia, improved hemostasis, without the need for sutures and less post-operative medication prescription; therefore, a faster treatment option can decrease the psychological distress of pediatric patients associated with conventional surgery (PINHEIRO et al., 2018).

Thus, the objective of the study is to carry out a literature review of labial and lingual frenectomies using the laser, its advantages and disadvantages.

II. HELITERATURE REVIEW

2.1 THE ORIGIN OF THE LINGUAL AND LABIAL BRAKE AND ITS CHARACTERISTICS

A frenulum is a small fold of muscle tissue that prevents an organ in the body from moving too far. There are two main phrenia in the mouth: the lingual and labial frenulum (KOMORI et al., 2017).

Generally, frenums are assessed from when children are young. If a frenum is malformed (too short, too long or too rigid), it can cause developmental problems and movement restrictions as the child grows (COTA et al., 2019).

The lingual frenulum is the strip of tissue that connects the underside of the tongue to the floor of the mouth. It is designed to connect the tongue to the jaw, but if the frenulum is too tight or too short (attached too close to the tip of the tongue), it may restrict the movement of the tongue. This condition is commonly called ankyloglossia and can affect speech, swallowing, breastfeeding and eating. A tie in the tongue can also inhibit the correct development of the jaw, which can cause long-term

orthodontic problems and / or lead to sleep apnea (SANTOS et al., 2018).

The aforementioned authors also mention that the labial frenum is the small strip of tissue that connects from the center of the upper lip between the upper front teeth. If the labial frenulum is too long, it can create a large gap between the two front teeth and / or cause gum recession as the frenum pulls the gums away from the teeth. In rarer cases, if the frenulum is too short / tight, it can create an open mouth position that inhibits the mouth from sealing properly. This can cause mouth breathing and inadequate development of the airways and jaw.

Ankyloglossia caused by abnormalities of the lingual frenulum is characterized mainly by fibrous adhesion of the tongue to the floor of the oral cavity. It is classified as complete or partial ankyloglossia, depending on the extent of adhesion. Cases of complete ankyloglossia are rare, with most cases exhibiting partial ankyloglossia, where the site of abnormal adhesion to the frenulum is the body of the tongue or the mandibular alveolar mucosa (KOMORI et al., 2017).

Ankyloglossia is usually detected at a young age due to dysphagia, masticatory difficulty, speech disorder or a regular examination. The upper labial frenulum is connected to the incisor papilla during the initial embryonic period. Subsequently, a gap develops gradually and the labial frenulum regresses with the development of the alveolar bone after birth and the eruption of the primary incisors. At around 10 years of age, after the end of the mixed dentition period and the eruption of the six teeth in the anterior region of the maxilla, the diastema naturally closes and stabilizes (OLIVEIRA; SANCHES; ANTONIO, 2019).

Consequently, according to Cota et al. (2019) it has been reported that, as long as no clear functional disorder is observed, it is better to continue with regular follow-up examinations of the upper lip frenulum until about 10 years of age (GARROCHO-RANGEL et al., 2019).

The clinical criteria used to diagnose ankyloglossia vary widely in the literature. Many authors use criteria based on the physical characteristics of the patient's oral anatomy. The most commonly used criterion is when the frenulum is abnormally short and thick, causing the tongue to be heart-shaped in its protrusion. The criterion also includes signs of functional impairment, such as the inability to project the tongue beyond the gingival margin and other indications that cause a reduction in tongue movement (OLIVEIRA et al., 2019).

A consensus on the diagnostic criteria is necessary to allow comparison of treatment studies. You should also

remember the importance of interdisciplinary diagnosis, dental and speech evaluation, to know whether to choose surgical or conservative treatment. Choosing the latter, some exercises are indicated that allow obtaining the stretching of the lingual frenulum (GARROCHO-RANGEL et al., 2019; SOUZA et al., 2015).

2.2 FRENECTOMY AND FRENULOTOMY

The frenum can be treated by frenectomy or by frenotomy procedures. Phrenectomy is the complete removal of the frenulum, including its fixation to the underlying bone, while frenotomy is the incision and reallocation of the frenal fixation (COTA et al., 2019).

Frenectomy can be performed using the routine scalpel technique, electrosurgery or using lasers. The conventional technique involves excising the frenulum using a scalpel. However, it carries the routine risks of surgery, such as bleeding and patient compliance.

The classical technique was introduced by Archer (1961) and Kruger (1964). This approach was advocated in cases of midline diastema with an aberrant frenzy to ensure the removal of muscle fibers that were supposedly connecting the orbicularis oris with the palate. This technique is an excision-type frenectomy that includes the interdental tissues and the palatal papilla, together with the frenulum (PATHIL and BOIER, 2017).

Miller's technique was advocated in 1985. This technique was proposed for cases of post-orthodontic diastema. The ideal time to perform this surgery is after the completion of the orthodontic movement and about 6 weeks before the removal of the braces. This not only allows tissue healing and maturation, but also allows the surgeon to use orthodontic appliances as a way to retain a periodontal dressing (PATEL et al., 2015).

Z plasty is indicated when there is hypertrophy of the frenulum with low insertion, associated with an inter-incisor diastema, and when the lateral incisors appeared without the diastema disappearing and also in cases of short vestibule. VY plasty can be used to lengthen the localized area, such as the wide frenum in the premolar molar area.

Electrosurgery is recommended in patients with bleeding disorders, in which the conventional scalpel technique carries a greater risk, associated with problems in obtaining hemostasis and also in non-adherent patients (COTA et al., 2019; PATEL et al., 2015).

However, despite the various modifications proposed for frenectomy, the widely followed procedure that remains is the classic technique. The classic technique leaves longitudinal surgical incision and scars, which can

lead to periodontal problems and anesthetic appearance, requiring other changes (GARROCHO-RANGEL et al., 2019).

The use of electrosurgery and lasers has also been proposed for frenectomy. The researchers advocated the use of an electrocautery tube because of its effectiveness and the safety of the procedure, light bleeding and the absence of postoperative complications. However, it is associated with certain complications that include burns, risk of explosion if combustible gases are used, interference with pacemakers and production of surgical smoke (CARDOSO et al., 2016).

2.3 LASER ACTION MECHANISM AND ITS MAIN ADVANTAGES

The energy emitted by a CO2 laser at a wavelength of 10.6 μm is efficiently absorbed in tissues with a high moisture content, and this laser is commonly used for resection and vaporization of soft tissues in the oral cavity (GARROCHO-RANGEL et al., 2019).

When using a scalpel, sutures are required for intraoperative hemorrhage, while the electric scalpel offers strong hemostatic effects through thick layers of coagulation and deformation. However, the surrounding areas are affected by heat, and problems such as enlarged wounds, infection, delayed healing and postoperative pain are likely to occur, with many cases also requiring sutures (PATEL et al., 2015).

Meanwhile, although the laser has a shallow depth of resection, it causes relatively no opening of the wound surface due to the location of the effects of heat, and the coagulation / deformation layers are adequately thick, implying reliable hemostasis and early healing (PATHIL and BOIER, 2017).

In an investigation using the visual analogue scale, it was reported that postoperative pain and discomfort during chewing and speech were statistically and significantly less common with the laser than with the conventional scalpel. Thus, when compared to surgery with an electric or cold scalpel, the use of lasers can reduce treatment time and simplify the general surgical procedure, reducing the burden on patients and facilitating cooperation. Therefore, it appears to be highly useful in surgical procedures, such as frenectomy, commonly performed in pediatric patients. However, when using this laser to treat abnormalities of the upper lip frenulum, attention must be paid to the power during laser application. Unlike cases of lingual frenectomy, excessive power can lead to damage to the bone surface, and constant care must be taken to protect the eyes, because the laser is applied to the upper lip (RIBEIRO e SILVA, 2019).

It has been reported that the erbium-doped aluminum and yttrium laser (Er: YAG), which, like the CO₂ laser, is commonly used for oral soft tissue diseases, can be used without local anesthesia, performing irrigation at the site of application, enabling procedures such as frenectomy with surface anesthesia only. However, as the Er: YAG laser has weaker hemostatic effects directly after resection than the CO₂ laser, many cases require the use of local anesthetics containing vasoconstrictors (PATEL et al., 2015).

III. METHODOLOGY

To carry out this systematic literature review, studies published between 2015 and 2020 were selected. The databases used for screening were LILACS, BBO and SCIELO using the combination of the keywords: Laser, Frenectomy, Lip brake, Frenulotomy (Laser, Frenectomy, Lip curl, Frenulotomy). This bibliographic search was completed in October 2020. During a first screening, only the combination of keywords was included. References to articles with no available abstract and those unrelated to the topic of specific interest were excluded.

IV. RESULTS AND DISCUSSION

In the first search performed, 273 articles were found that had some relation to the theme now proposed. Subsequently, we sought to perform a thorough reading of the titles of the articles, leaving only 98. Then, we opted for reading the abstracts, where only 53 studies were selected to be inserted in a more detailed analysis. At the end of these verification and analysis steps, 13 studies remained that met the inclusion criteria. It was found that the most significant portion of articles was found in the PUBMED database (6 articles), followed by SCIELO (4 articles) and LILACS (3 articles).

Of the 13 selected studies, five were published in a national journal and eight were published in American journals, shown in Chart 1.

This review consists of 13 articles published between 2015 and 2020, two published in 2015, two in 2016, one in 2017, three in 2018, four in 2019 and one in 2020. Of the selected sample, five were case studies, three comparative studies, two clinical studies, a cross-sectional retrospective study, a literature review and a retrospective clinical study, distributed, as shown in chart 1.

Table.1: References used in this review.

Authors	Title	Year	Periodical	Methodology
Cardoso et al.	Vantagens da Frenectomia Labial por laser diodo de alta intensidade	2016	INPerio	Case study
Cota et al.	Frenectomia para restituição fono-motricial da língua	2019	REAS/EJCH	Clinical study
Garrocho-Rangel et al.	Treatment of ankyloglossia with dental laser in paediatric patients: Scoping review and a case report	2019	European Journal of Paediatric Dentistry	Bibliographic research
Komori et al.	Clinical Study of Laser Treatment for Frenectomy of Pediatric Patients	2017	Int J Clin Pediatr Dent	Clinical study
Martinelli et al.	Tongue position for lingual frenulum assessment	2020	Rev. CEFAC	Retrospective cross-sectional study
Medeiros Júnior et al.	Labial frenectomy with Nd:YAG laser and conventional surgery: a comparative study.	2015	Lasers Med Sci	Comparative study
Oliveira et al.	Tratamento de anquiloglossia parcial através de frenectomia: relato de caso	2019	Arch Health Invest	Case study
Olivi et al.	Laser labial frenectomy: a simplified and predictable technique.	2018	Eur J Paediatr Dent	Retrospective clinical study

	Retrospective clinical study			
Patel et al	Comparison of labial frenectomy procedure with conventional surgical technique and diode laser	2015	Journal of Dental Lasers	Comparative study
Pinheiro et al	Duas propostas cirúrgicas para frenectomia labial – convencional e a laser de alta potência	2018	Rev port estomatol med dent cir maxilofac	Case study
Ribeiro e Silva	Frenectomia lingual com uso do laser de alta potência em odontopediatria: relato de caso.	2019	Rev Nav Odontol	Case study
Tomazini et al.	Aplicação de laser em cirurgia de frenotomia labial inferior – relato de caso.	2016	Full Dent Sci	Case study
Uraz et al	Patient perceptions and clinical efficacy of labial frenectomies using diode laser versus conventional techniques	2018	J Stomatol Oral Maxillofac Surg	Comparative study

In the presence of a frenulum, two procedures are proposed for its treatment: frenectomy and frenotomy. Frenectomy involves the complete removal of the frenulum, including its adherence to the bone; while the frenotomy incision and repositioning of the frenulum adhesion (COTA et al., 2019; PATEL et al., 2015).

Frenectomy is the best option to resolve this condition, where the frenulum is correctly reinserted during its

healing after the surgical procedure. The surgical technique can be performed in a conventional or laser way, differentiation in the execution, healing and postoperative. Conventional frenectomy is a simple procedure that consists of using scissors and scalpels to cut or section the lingual frenulum and posterior suture for healing the first intention. The use of high-power laser is indicated in frenectomy due to its exclusive interaction with the exposed tissue due to its wavelength and specific active medium, in addition to its secondary therapeutic effects that provide a more effective healing and a better postoperative to the patient. (SANTOS et al., 2018; MARTINELLI et al., 2020).

The frenectomy technique with the use of scalpels was proposed as a conventional and classic technique for removing an aberrant device; however, this technique has the disadvantage of causing more bleeding and a greater possibility of postoperative complications. On the contrary, the techniques that use the laser reduce the risk of bleeding and complications, but can cause burns, risk of explosion in the use of gases, risk of interfering with pacemakers and production of surgical smoke (MEDEIROS JÚNIOR et al., 2015 ; SEIFI and MATINI, 2017; TOMAZINI et al., 2016).

The association of the surgical procedure performed with the high power laser and the application of the low power laser in the infrared wavelength has its scientifically proven effectiveness. The low-power laser has biomodulatory effects, acting directly on cellular mitochondria, accelerating cellular metabolism and, consequently, generating benefits to the requirements. The low-power laser used in adjustment parameters helps in the healing process and the onset of pain or edema (KOMORI et al., 2017; MARTINELLI et al., 2020).

The clinical advantages and disadvantages of each laser have been reported mainly in the form of clinical reports, with few studies comparing the postoperative results between the different techniques. According to the clinical trials found, comparisons can be made between conventional techniques with a scalpel and the techniques that use the Nd: YAG laser and the CO₂ laser, with the main variables being the time of surgical intervention, the postoperative pain at talking and chewing and postoperative complications (PATHIL and BOIER, 2017; RIBEIRO and SILVA, 2019; ROZO et al., 2015; URAZ et al., 2018).

Laser techniques do not require anesthesia, generate less pain, provide better visibility during the operation, do not require periodontal dressings, offer better healing and less scarring. The laser allows the area to be sterilized and

its use does not require the use of sutures. Of the studies, one reported post-surgical complications related to the level of bone exposure of the inserted gingiva after one week of intervention (MEDEIROS JÚNIOR et al., 2015; OLIVI et al., 2018). The authors state that the operator's inattention when using the laser and generating greater thermal energy could explain these complications.

The Nd: YAG and CO 2 laser showed better results in relation to pain and discomfort after speech and chewing. The CO 2 laser has been used for lingual frenectomies, with the advantages of being simple, fast, causing little pain, absence of infections, absence of paresthesia, in addition to leaving little or no scar (SEIFI and MATINI, 2017). The study by Haytac et al. (2016) compared the degree of postoperative pain when performing frenectomies with a scalpel and with a CO2 laser, the laser group showed less pain and functional complications (speech and edema) ($p < 0.001$), in addition to requiring less analgesics ($p < 0.001$). They conclude that the CO2 laser offers a safe, effective and acceptable alternative for performing frenectomies.

It is also noteworthy that oral tissues (mainly covering fabrics) have more than 90% water in their composition and, considering the affinity of the diode for wet tissues, the diode laser is highly indicated for oral surgery (RIBEIRO and SILVA, 2019).

The findings of studies by Garrocho-Rangel et al. (2019) show that early diagnosis and treatment of ankyloglossia are fundamental for the adequate functional oral development of pediatric patients. Laser surgery for lingual frenulectomy provides a more efficient and comfortable treatment for the child and the pediatric dentist compared to traditional scalpel / blade methods.

Cardoso et al. (2016) demonstrated the advantages of a high-intensity surgical laser (Nd: YAG; 808 nm; 1.2 W; 20 pps; 126 J) from a clinical case report of frenectomy performed on a female patient, with 34 years old, who has persistent labial brake associated with superior interincisal diastema. The surgical procedure with high-intensity soft tissue laser has some advantages, such as the reduction in surgical time, with a reduction in postoperative morbidity and symptoms.

Twenty articles were reviewed to prepare this Literature review, from different areas, to obtain an enriched work. It was found, however, that the laser is a more practical and less invasive medium used than the conventional method.

V. CONCLUSION

From this review, it is possible to observe that laser technology has been considered an alternative to conventional techniques, presenting several advantages such as: shorter operative work time, cauterization and sterilization of tissues, hemostasis, less need for local anesthesia and less post-operative complications (pain, edema and infection). The laser also facilitates access and visualization due to the lack of interposed instruments and bleeding in the operative field. In addition, the need for suture is eliminated and the uniform depth of the surgical site is maintained, reducing unnecessary damage to the tongue muscle. For all these resources, the laser is well tolerated by all patients in different age groups.

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