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Laser Photobiomodulation Therapy in Post-Surgical Facial Paralysis: a Report of Two Cases

Terapia de Fotobiomodulação a Laser na Paralisia Facial Pós-Cirúrgica: Relato de Dois Casos

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Abstract

The current literature describes various types of surgical approaches for the treatment of mandibular condyle fractures, each with its own indications, benefits, and risks that should be evaluated during preoperative planning. Factors such as aesthetics, exposure of the desired area, and anatomical structures along the surgical path need to be considered. Although an ideal scenario would involve surgical procedures without accidents or postoperative complications, this is not always achievable. The facial nerve is one of the critical structures that may be damaged during surgical procedures to access condylar fractures. Managing or mitigating these sequelae is as crucial as attempting to avoid them. Laser Photobiomodulation Therapy (LPBMT) represents a viable alternative in the treatment of postoperative facial paralysis. It is a non-invasive and painless approach that enhances functional nerve activity, prevents or reduces degeneration in motor neurons, and promotes axonal growth and myelination. In the reported cases, patients with left mandibular condyle fractures were treated using a retromandibular approach and rigid internal fixation, achieving satisfactory fracture resolution, but facial paralysis developed. To address facial paralysis, LPBMT was administered in ten sessions, applying infrared waves at a frequency of 4J. In both cases, LPBMT showed promising results in treating facial paralysis, facilitating adequate contraction of the facial mimic muscles and even complete reversal of paralysis symptoms.

Keywords: Low Intensity Light Therapy. Facial Palsy. Facial Nerve Injuries.

Resumo

A literatura atual descreve vários tipos de abordagens cirúrgicas para o tratamento de fraturas do côndilo mandibular, cada uma com suas indicações, benefícios e riscos que devem ser avaliados durante o planejamento pré-operatório. Fatores como estética, exposição da área desejada e estruturas anatômicas ao longo do caminho cirúrgico precisam ser considerados. Embora um cenário ideal envolvesse procedimentos cirúrgicos sem acidentes ou complicações pós-operatórias, isso nem sempre é alcançável. O nervo facial é uma das estruturas críticas que pode ser danificada durante os procedimentos cirúrgicos para acesso a fraturas condilares. Gerenciar ou mitigar essas sequelas é tão crucial quanto tentar evitá-las. A Terapia de Fotobiomodulação a Laser (LPBMT) representa uma alternativa viável no tratamento da paralisia facial pós-operatória. É uma abordagem não invasiva e indolor que aumenta a atividade funcional dos nervos, previne ou reduz a degeneração nos neurônios motores e promove o crescimento axonal e a mielinização. Nos casos relatados, pacientes com fraturas do côndilo mandibular esquerdo foram tratados por meio de uma abordagem retromandibular e fixação interna rígida, alcançando uma resolução satisfatória da fratura, mas desenvolvendo paralisia facial. Para tratar a paralisia facial, a LPBMT foi administrada em dez sessões, aplicando ondas infravermelhas a uma frequência de 4J. Em ambos os casos, a LPBMT mostrou resultados promissores no tratamento da paralisia facial, facilitando a contração adequada dos músculos da expressão facial e até mesmo a reversão completa dos sintomas de paralisia.

Palavras-chave: Terapia com Luz de Baixa Intensidade. Paralisia Facial.Traumatismos do Nervo Facial.

1 Introduction

Facial trauma is a common occurrence in the daily practice of an oral and maxillofacial trauma service, and studies indicate that between 28% and 60% of fractures occur in the mandible, with approximately 50% of these being condylar fractures[1-3]. For the treatment of this type of fracture, there are two main approaches: closed reduction through Maxillomandibular Fixation (MMF) or open reduction and Rigid Internal Fixation (RIF). Currently, with advances in bone fixation technologies, RIF is preferred, performed using plates and screws due to easy access and better outcomes for patients[4].

Current literature presents a variety of surgical approaches for the open treatment of mandibular fractures, each with its own indications, benefits, and drawbacks that must be evaluated during preoperative planning. Among the main factors that need to be considered when choosing the surgical approach in the facial region are aesthetics, adequate exposure of the desired area, and anatomical structures present along the path. Since the face is a region rich in nerves and vessels, the Oral and Maxillofacial Surgeon must be trained to avoid or mitigate injuries to these structures[4].

Peripheral nerve injuries are damages to the nerves caused by mechanical, chemical, or physical factors, resulting in paresthesia and facial paralysis. These injuries are often

associated with extractions of lower third molars, orthognathic surgeries, implant placements, trauma, and anesthetic techniques that can cause nerve injuries[5]. It is not surprising that a variety of resources, ranging from medications and physiotherapy to more invasive surgical procedures, are employed in the treatment of these cases[6].

Although an ideal surgical procedure without accidents or postoperative complications is the ideal scenario, it is known that this is not always possible. Therefore, the ability to resolve or mitigate these sequelae is as important as trying to avoid them[4,7].

In the case of condyle fractures requiring a surgical approach, the Retromandibular Approach (RA) is routinely the most used, as it provides good exposure of the desired area, allowing proper positioning of the titanium plates to reduce and fix such fractures. However, despite the advantages, this approach requires bordering or passing through the parotid gland, where branches of the VII cranial nerve (facial nerve) pass, a mixed nerve whose functions include the motility of the facial mimic muscles. Injuries to its superficial branches result in facial paralysis, which can be transient or permanent[4,7].

The two main types of causes of facial nerve injury that result in nerve disruption are traumatic and iatrogenic injuries[8]. Classified as a mixed nerve, the facial nerve (FN) has a sensory root and a motor root, and it divides in the face into five terminal branches: buccal, temporal, zygomatic, cervical, and marginal mandibular. It originates in the brainstem at the facial nucleus, exits laterally from the bulbopontine sulcus, enters the temporal bone through the internal acoustic meatus, and exits the skull via the stylomastoid foramen, forming an extratemporal segment[9].

The prevalence of Facial Nerve (FN) injury after surgical treatment of mandibular condyle fractures ranges from 12% to 48%, which can result in partial or total hemifacial paralysis, compromising facial expression movements, and causing a negative impact on individuals' quality of life[10,11].

In this context, the dentist can work to improve facial symmetry and the individuals' self-esteem by using different techniques, either individually or in combination. Among the various procedures that dental professionals can choose to treat facial paralysis, the following stand out: acupuncture, laser therapy, electrotherapy, suspension threads, hyaluronic acid, and botulinum toxin[12]. Although there are various treatment options for nerve injuries, Laser Photobiomodulation Therapy (LPBMT) stands out as atraumatic technique that provides effective management in the facial area for patients[11].

LPBMT emerges as an alternative in the treatment of facial paralysis, being a non-invasive and painless approach that increases functional activity of the injured nerve, prevents or reduces degeneration in motor neurons, and improves axonal growth and myelination[11,13].

Thus, this study aims to report the resolution of two clinical cases of facial paralysis resulting from the retromandibular approach for the treatment of mandibular condyle fracture using LPBMT as a therapeutic modality.

2 Case Reports

2.1 Case 01

This case report was submitted to the Research Ethics Committee of Adventist College of Bahia State through the Plataforma Brasil (CAEE No. 81499724.7.0000.0042) approved by Opinion No. 7.024.825 according to regulated guidelines in research involving human beings (Resolution 466/2012).

Patient A.L.A, a 44-year-old female, attended the Oral and Maxillofacial Surgery and Traumatology Service of the General Hospital of Bahia State (HGE) presenting a low fracture of the right mandibular condyle resulting from physical aggression. The indicated treatment was reduction and fixation through the retromandibular approach and the use of two straight plates and eight screws of the 2.0 millimeter (mm) system (NEORTHO).

In the seven-day postoperative evaluation, adequate tissue healing and restoration of mandibular functions were observed. However, the patient developed motor alterations related to the facial expression muscles, with a deficiency of mimicry in the upper and middle thirds of the face, resulting from injuries to the frontal, zygomatic, and buccal branches of the facial nerve on the right hemiface, caused by the retromandibular approach.

To mitigate or even reverse the nerve injury, the patient visited the dental clinic of Bahia State School of Medicine and Public Health (EBMSP) for the application of LPBMT with a low-power laser (DMC®, São Carlos, São Paulo, Brazil), at a wavelength of 808 nanometers (nm), power of 100 milliwatts (mW), spot size of 0.028 cm, energy density of 35.714 J/cm², and a punctual application twice a week at 48-hour intervals, using 4J for 40 seconds, performed at five points along each branch of the facial nerve (frontal, zygomatic, and buccal). The treatment was conducted solely using LPBMT.

Figure 1 - Photograph taken on the day of the first LPBMT session. There is inadequate contraction of the facial expression muscles on the right side of the face, indicating hemifacial paralysis resulting from a retromandibular approach using the retroparotid technique. A) Smiling facial expression test. B) Facial pout test

Source: the authors.

After ten sessions of LPBMT, adequate contraction of the facial mimic muscles was observed, indicating recovery of nerve action (Figure 2).

Figure 2 - Photograph taken after the last application of the LPBMT protocol. There is adequate contraction of the facial expression muscles, indicating a resolution of the right-sided hemifacial paralysis. A) Smiling facial expression Test. B) Facial pout test. C) Smiling facial expression test in lateral view. D) Facial pout test in lateral view

Source: the authors.

The LPBMT applied in the described case was able to stimulate nerve regeneration, as well as the recovery of the affected facial muscles. A protocol of ten sessions, applied twice a week with 48-hour intervals, proved to be effective in treating the paralysis, as the patient showed normalization of facial muscle movements, demonstrating significant improvement in facial symmetry.

2.2 Case 02

This case report was submitted to the Research Ethics Committee of Adventist College of Bahia State through the Plataforma Brasil (CAEE No. 81499724.7.0000.0042) approved by Opinion No. 7.024.825 according to regulated guidelines in research involving human beings (Resolution 466/2012).

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In the seven-day postoperative evaluation, adequate tissue healing and restoration of mandibular functions were observed. However, the patient developed motor alterations related to the facial expression muscles, with a deficiency of mimicry in the upper and middle thirds of the face, resulting from injuries to the frontal, zygomatic, and buccal branches of the facial nerve on the right hemiface, caused by the retromandibular approach.

To mitigate or even reverse the nerve injury, the patient visited the dental clinic of the School of Bahia State of Medicine and Public Health (EBMSP) for the application of LPBMT with a low-power laser (DMC®, São Carlos, São Paulo, Brazil), at a wavelength of 808 nanometers (nm), power of 100 milliwatts (mW), spot size of 0.028 cm, energy density of 35.714 J/cm², and a punctual application twice a week at 48-hour intervals, using 4J for 40 seconds, performed at five points along each branch of the facial nerve (frontal, zygomatic, and buccal). The treatment was conducted solely using LPBMT.

Figure 3 - Photograph taken on the day of the first LPBMT session. There is inadequate contraction of the facial expression muscles on the left side of the face, indicating hemifacial paralysis resulting from a retromandibular approach using the retroparotid technique. A) Facial pout test. B) Frontal facial mobility test. C) Smiling facial expression test

Source: the authors.

After ten sessions of LPBMT, adequate contraction of the facial mimic muscles was observed, indicating recovery of nerve action (Figure 4).

Figure 4 - Photograph taken after the last application of the LPBMT protocol. There is adequate contraction of the facial expression muscles, indicating a resolution of the left-sided hemifacial paralysis. A) Facial pout test. B) Frontal facial mobility test. C) Smiling facial expression test

Source: the authors.

The LPBMT applied in the described case was capable of stimulating nerve regeneration, as well as the recovery of the affected facial muscles. A protocol of ten sessions, applied twice a week with 48-hour intervals, proved to be effective in treating the paralysis, as the patient showed normalization of facial muscle movements, demonstrating significant improvement in facial symmetry.

3 Discussion

When facial nerve paralysis occurs, it establishes a condition that affects appearance and results in the immobility of any structure innervated by the nerve, impacting expression

and interfering with interpersonal relationships[11].

The facial nerve originates from the brainstem, travels through the temporal bone, and circulates towards the stylomastoid foramen, where it distributes various branches that innervate the facial mimic muscles. Among the variety of nerves, it is considered one of the most prone to injury and consequently compromises facial expression[14]. The etiology affecting the facial nerve leading to paralysis is highly variable, mostly due to surgical iatrogenies, tumors, maxillofacial infections, metabolic disorders, and idiopathic causes[15].

Poeta et al.[15] state that maxillofacial trauma emergencies are frequent and can affect all thirds of the face. These traumas tend to rupture nerves and generate neurosensory alterations, as many of these fractures expose the facial and/or trigeminal nerves. In their work, Hurrell et al.[16] declare that although the literature addresses few reports on neurosensory disorders due to oral and maxillofacial care, occasions that produce nerve compression or displacement can result in motor and/or sensory nerve alterations. Thus, it is understood that these injuries are not only caused by trauma but also by the operator's handling.

According to Silva et al.[17], surgeons tend to choose open reduction and fixation of condyle fractures and point out that the retromandibular approach is the most used as it provides an excellent view of the surgical field and facilitates the reduction and RIF process of bone segments. However, due to its characteristic of being an approach with easy proximity to the facial nerve, greater care is essential to avoid injury to this nerve, which is the main complication of this technique.

Bruneau et al.[18] evaluated 96 patients with subcondylar mandibular fractures using the trans-parotid retromandibular approach and identified transient facial nerve paralysis in 17.2%, with total nerve structure recovery after six months. However, in the research conducted by Ahmed et al.[19], comparing the retromandibular and trans-parotid approaches, a prevalence of 13% to 22% of transient paralyses and a prevalence of 5% of permanent paralyses were observed in both techniques, respectively. In the same study, some authors stated that the trans-parotid retromandibular approach had a higher occurrence of nerve dysfunction, causing more permanent paralysis.

In their systematic review and meta-analysis, Moraiss et al.[20] affirm that the occurrence of FN injury in mandibular condyle surgeries varies from 1% to 48%. The intraoral approach was reported with a lower rate of 0.72%. In the same study, they declared that permanent facial nerve injury is lower in all approaches, being 2.2% in the submandibular approach, 1.4% in the trans-parotid retromandibular approach, and 0.3% in the pre-auricular approach.

Regarding the recovery and treatment of patients with paralysis, Lima et al. (2020)[21] affirm that interventions such as physiotherapy, LPBMT, and medication therapies are well-indicated but can have varied results depending on the level and duration of paralysis. LPBMT is described as a beam of light in specific waves, capable of generating electromagnetic radiation, acting on mitochondria, increasing protein synthesis, and producing adenosine triphosphate (ATP). In nerve treatments, it promotes acceleration of axon growth, regeneration after injuries, myelination, and assists in nerve conduction, which constitute regenerative and anti-inflammatory effects. In more severe cases where nerve sectioning occurred, Li et al.[22] report the possible need for surgical interventions, with primary microsurgical repair being essential. When primary contact is not possible, a nerve autograft may be performed, a technique employed only in the most severe cases where other repair approaches were ineffective.

LPBMT is highly recommended for the treatment of facial paralysis and is considered a painless and non-invasive therapeutic method, ideal for all types of patients. It is a form of therapy that provides activation of important antioxidant enzymes, giving the body a greater ability to return to its homeostasis activity and proper performance[21,23].

Kim et al.[11] highlight that LPBMT provides local effects that enhance nerve regeneration, reducing retrograde degeneration in post-traumatic neuron situations. Vanderlei et al.[23] also report that, according to the consulted works, there is no specific protocol for cases of facial paralysis. Despite this lack of a specific protocol, studies suggest that LPBMT has shown significant advantages in reducing treatment time and effectiveness in facial paralysis, as seen in the cases mentioned where patients showed improvement after an average of ten laser sessions, consistent with the data found in the literature[24].

Reducing the risks of permanent facial nerve dysfunction is of utmost importance. In this regard, intraoperative neuromonitoring is introduced as an alternative to support surgeons during procedures. Transoperative FN monitoring is performed using electromyography based on the registration of the Compound Muscle Action Potential (CMAP) of the facial muscles. CMAP is stimulated by the electrical action of the facial nerve with the probe or mechanical activity of the nerve. Thus, monitoring provides a clearer visualization of the FN action and its direction, consequently avoiding improper handling of its branches. The main disadvantage is the high cost[25].

4 Conclusion

Given the significant importance of the face for both aesthetic and functional factors, even minimal nerve alterations can have considerable repercussions on patients' quality of life. When analyzing facial paralysis, there is a clear correlation between retromandibular approaches and the incidence of paralysis involving the seventh cranial nerve. In most cases, these nerve injuries and deficits are transient, a fact that does not lessen the patient's discomfort regarding this condition. In both described cases, LPBMT showed positive results in the treatment of facial paralysis, facilitating the effective

contraction of the muscles that control facial expression and even leading to the complete reversal of paralysis symptoms. However, more studies and research are needed to establish increasingly specific and effective protocols.

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