Int. J. Odontostomat.,
17(2):142-154, 2023.

Knowledge, Attitudes, and Practices on New Treatment Modalities for Temporomandibular Dysfunctions and Orofacial Pain

Conocimientos, Actitudes y Prácticas sobre Nuevas Nodalidades de Tratamiento de las Disfunciones Tempomanibulares y el Dolor Orofacial

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MATOS, J. D. M.; QUEIROZ, D. A.; ALCÂNTARA, M. A. S.; MOURA DOS SANTOS, A. C.; DE VASCONCELOS, J. E. L.; LOPES, G. R. S.; BOTTINO, M. A. & ANDRADE, V. C. Knowledge, attitudes, and practices on new treatment modalities for temporomandibular dysfunctions and orofacial pain. *Int. J. Odontostomat., 17(2)*:142-154, 2023.

ABSTRACT: The present study proposed to describe, through a literature review, the use of new therapeutic management which allows for offering a better quality of life to individuals affected by these pathologies. A bibliographic search was conducted in the main health databases PUBMED (www.pubmed.gov) and Scholar Google (www.scholar.google.com.br), in which studies published from 1987 to 2023 were collected. In the first stage, the list of retrieved articles was examined by reading the titles and abstracts. In the second stage, the studies were selected by reading the full contents. Two authors (JDMM and DAQ) performed stages 1 and 2. Experimental, clinical, case-control, randomized controlled, and laboratory cohort studies, case reports, systematic reviews, and literature reviews, which were developed in living individuals, were included. Therefore, articles that did not deal with the subject in question, letters to the editor, opinion articles, duplicated literature in databases, and literature that did not address the variables under study, were excluded. Contemporary dentistry uses alternative treatments capable of improving the patient's condition since a cure is not always possible. Therefore, the possibility of improving the quality of life becomes an important point to be reached. Evidence-based healthcare has made great advances in recent decades, especially in the areas of orofacial pain, TMD, and occlusion, especially related to orthodontic, prosthetic, and restorative care.

KEYWORDS: Temporomandibular joint, temporomandibular joint disorders, facial pain, dental occlusion, dental research.

INTRODUCTION

The stomatognathic system corresponds to a functional unit of the body that is responsible for speech, chewing, and swallowing (Gedrange *et al*., 2017). Countless structures involve the stomatognathic system; whether bones, joints, ligaments, teeth, and muscles (Cuccia & Caradonna, 2009; Gedrange *et al*., 2017).

In this context, a structure in particular that gains notoriety is the Temporomandibular Joint (TMJ), which is considered the most complex region of the human body since it is composed of mandibular condyles and temporal bones (Fulmer & Harms, 1989). These joints directly connect the jaw bone to the skull bone and allow functions such as chewing and speech to be

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Received: 2023-02-28 Accepted: 2023-03-15

performed (Fulmer & Harms, 1989; Buescher, 2007). When there is a limitation in these structures, preventing joint flexibility and compromising the muscles responsible for controlling any jaw movement, temporomandibular joint (TMD) dysfunction occurs (Gauer & Semidey, 2015; Yadav *et al*., 2018).

TMDs are functional alterations in the stomatognathic system, and they affect approximately 70 % of the population, and at least one in four people with a TMD sign reports symptoms related to mastication, thus patients with involvement in the maxillomandibular complex, such as bruxism are constantly with dental and prosthetic elements under high occlusal load, in turn being considered as occlusal athletes since due to constant work of the joint and muscles involved, it is required to carry out normal day-to-day activities -day (Grade *et al*., 2008). TMD conditions may be accompanied by orofacial pain (OFP), including headaches, joint noises, trismus, bruxism, muscle fatigue and tension, refractory pain, neuralgia, trigger points, and joint pain (Ahmad & Schiffman, 2016; Graff-Radford & Abbott, 2016; Racich, 2018). TMD/OPD cases are not the same, there are types and subtypes of disorders, so the same person can have more than one type, thus making diagnosis difficult (Liu & Steinkeler, 2013; Gauer & Semidey, 2015).

There are several studies developed for the treatment of TMD/OFP, since its etiology is considered to be multifactorial (Liu & Steinkeler, 2013; Gauer & Semidey, 2015). Several factors are involved in these disorders, including genetic factors, parafunctional oralhabits, mainly habits of clenching teeth, biting nails, chewing gum or biting objects frequently, and a history of head and neck trauma (Greene, 1995; Liu & Steinkeler, 2013; Gauer & Semidey, 2015). In addition, the emotional state of the patient can be highlighted, which can have a direct influence on the prognosis of the pathology (Greene, 1995).

The therapeutic management for TMD/OFP is somewhat complex, but in general, the practice of clinical conduct is based on scientific evidence (Christidis *et al*., 2019). Therefore, it is recommended that no irreversible treatment should be performed (Velly *et al*., 2013; Christidis *et al*., 2019). Inaccurate diagnoses are limiting factors for the determination of therapeutic resources capable of guaranteeing a favorable prognosis in several cases (Liu & Steinkeler, 2013). Commonly performed procedures are explanations about TMD/OPD; guidelines regarding health care and the individual's state of emotional stress; ergonomics; physical self-regulation; analgesics and anti-inflammatories; moist heat, occlusal adjustments, especially in cases that require tooth wear or the addition of restorative material; orthodontic and/or orthopedic appliances for bite correction; prosthetic oral rehabilitation and the application of anesthetics without vasoconstrictor, in cases where there is the persistence of active trigger points (Wieckiewicz *et al*., 2015; Graff-Radford & Abbott, 2016; Racich, 2018). In addition to these elucidated therapies, we have surgical therapies that were widely used in the past (Hall *et al*., 2002; Dolwick & Widmer, 2018). However, currently, the most invasive therapies are rarely indicated, being performed only in specific cases (Dolwick *et al*., 2018). It is important to emphasize that complementary therapies such as TENS, FES, and dry needling can help in the therapeutic management of these cases (Butts *et al*., 2017).

Transcutaneous electrical nerve stimulation (TENS) is nothing more than a procedure designed to relieve peripheral pain through non-painful impulses along the skin (Chellappa & Thirupathy, 2020). These discharges release endogenous analgesics and decrease patient discomfort (Fertout *et al*., 2022). As a complementary therapy when associated with dry needling or dry needling, it demonstrates promising results about analgesia (Wieckiewicz *et al*., 2015; Butts *et al*., 2017).

Dry needling is a therapy that consists of applying acupuncture needles directly to trigger points formed in the muscle fiber (Cummings & White, 2001; Vier *et al*., 2019). These points, resulting from injuries caused by day-to-day tensions, these stresses are mainly related to sudden and excessively fast movements, falls, ischemia, inflammation, absence or excess of physical exercises, emotional stress, nutritional deficiencies, and changes in posture (Tough *et al*., 2009; Machado *et al*., 2018). The formation of nodules, which are palpable through the fingertips, is caused by excessive stretching or shortening of the muscle fiber, which contracts excessively, to the point of preventing progressive relaxation (Ong & Claydon, 2014; Liu *et al*., 2018). Therefore, the oxygenation of the region becomes deficient due to poor blood circulation, causing pain (Turo *et al*., 2015; Aksu *et al*., 2019). In this sense, needling acts by stimulating the release of opioid substances (enkephalin and serotonin) by the body itself, controlling the individual's sensation of pain (Kietrys *et al*., 2014; Cagnie *et al*., 2015). In turn, stimulates the central and peripheral nervous system to release neurotransmitters that favor the process of restoring and maintaining health (Ibuldu *et al*., 2004; Tesch *et al*., 2021).

Functional electrical stimulation (FES) is a form of treatment that uses low-frequency electrical current to cause contraction of paralyzed or weakened muscles resulting from upper motor neurons injury, such as strokes, spinal cord trauma or encephalic skulls, cerebral palsy, among others (Troyk & Donaldson, 2001; Braz *et al*., 2009). This electrical current is specified in such a way that it enables functional muscle contraction, thus corresponding to its objective, the rehabilitation of the individual (Ayesh *et al*., 2007; Braz *et al*., 2009).

Faced with a growing search for new treatment therapies for temporomandibular disorders and orofacial pain, the present study proposed to describe, through a literature review, the use of new therapeutic managements which allow offering a better quality of life to individuals. affected by these pathologies.

Evidence Acquisition

Source Selection. A bibliographic search was conducted in the main health databases PUBMED (www.pubmed.gov) and Scholar Google (www.scholar.google.com.br), in which studies published from 1987 to 2023 were collected. In the first stage, the list of retrieved articles was examined by reading the titles and abstracts. In the second stage, the studies were selected by reading the full contents. Two authors (JDMM and DAQ) performed stages 1 and 2. Experimental, clinical, case-control, randomized controlled, and laboratory cohort studies, case reports, systematic reviews and literature reviews, which were developed in living individuals, were included. Therefore, articles that did not deal with the subject in question, letters to the editor, opinion articles, duplicated literature in databases, and literature that did not address the variables under study, were excluded.

Data Source. Through bibliographic search 120 articles were selected, of which 80 articles were extracted from PUBMED (www.pubmed.gov) and 40 Scholar Google (www.scholar.google.com.br). The following specific medical subject titles and keywords were used: Temporomandibular Joint (DeCS/MeSH Terms); Temporomandibular Joint Disorders (DeCS/MeSH Terms); Facial Pain (DeCS/MeSH Terms); Dental Occlusion (DeCS/MeSH Terms); Dental Research (DeCS/MeSH Terms).

RESULTS

According to the tabulation of the collected data, it can be seen that the average publication of articles in the period from 1987 to 2021 from the Pubmed database was 2.96 and with a standard deviation of 2.42. While at Scholar Google, the average was 1.48, and the standard deviation was 1.84. Thus, it was possible to verify that there was a significant variation in the number of articles in both databases.

TMDs are functional changes in the stomatognathic system, which affect approximately 70 % of the population. One in four people with TMD signs report symptoms related to chewing (Grade *et al*., 2008). TMD cases may be accompanied by orofacial pain (OFP), including headaches, joint noises, trismus, bruxism, muscle fatigue and tension, refractory pain, neuralgia, trigger points and joint pain (Stegenga *et al*., 1992; Zakrzewska & Jensen, 2017). TMD/OPD cases are not the same, there are types and subtypes of disorders, so the same person can have more than one type, thus making diagnosis difficult (Lam *et al*., 2001; Ahmad & Schiffman, 2016).

Therefore, there are several studies developed for the treatment of TMD/OFP, since its etiology is considered multifactorial (Liu *et al*., 2013). Several factors are involved in these disorders, including genetic factors, parafunctional habits, mainly acts such as teeth clenching, nail biting, chewing gum or biting objects frequently, in addition to a history related to head and neck trauma (Mohlin & Koop, 1978; Nakamura *et al*., 1983; Liu *et al*., 2013). The emotional state of the patient is capable of having a direct influence on the prognosis of the pathology (Dıraço?lu *et al*., 2016). In this case, contemporary dentistry uses alternative treatments capable of improving the patient's condition, since the cure is not always possible. Therefore, the possibility of improving the quality of life becomes an important point to be reached (Van der Meer *et al*., 2017; Alves *et al*., 2018).

Data analysis and integration

Neurophysiopathology of Pain. The neuropathophysiology of orofacial pain is directly linked to the somesthetic functionality of the nervous system, that is, the interpretation of different bodily stimuli (Stegenga *et al*., 1992; Zakrzewska & Jensen, 2017). Orofacial pain is considered to comprise nociceptive symptoms related to the bucomaxillofacial complex (Ahmad & Schiffman, 2016; Graff-Radford & Abbott, 2016; Racich, 2018).

Specialized sensory receptors called nociceptors are nerve endings whose function is to transmit pain sensitivity (Kern *et al*., 2004). These mechanisms are embedded in myelinated and fast-conducting A-delta fibers and in unmyelinated and slow-conducting C fibers (Carraro *et al*., 2005; Salmons *et al*., 2005). All tangible stimuli to somesthetic afferents from the oral mucosa, tongue, part of the dura mater, periodontium, dental pulp, and gingiva are transmitted by the trigeminal nerve to the brainstem permeated by first-order neurons (Peckham & Knutson, 2005).

The stimulus path subsequently runs through the trigemiothalamic tract, conducting impulses to the brain, in the thalamus, by second-order neurons (Rowe, 1992; Monaco *et al*., 2017; Mummolo *et al*., 2020). Third-order neurons transmit impulses from the thalamus to the primary somatosensory cortex (Rowe, 1992). After the interpretation of painful symptoms, through descending inhibitory pathways that travel from the brainstem to the spinal cord, pain is modulated in the central nervous system with increased neurotransmission of noradrenaline, serotonin, and endogenous opioid molecules, such as endorphins, enkephalins, and dynorphins (Rushton, 1997; Rushton, 2003; Thrasher & Popovic, 2008).

Nociceptive pain is perceived from a chain of events that starts from the stimulation of free nerve endings (TNLs) (Rowe, 1992; Monaco *et al*., 2017; Mummolo *et al*., 2020). TNLs are the simplest sensory endings of an afferent nerve and are distributed throughout all body tissues, especially the skin (Bender *et al*., 2013; Johnson, 2017).

TNLs are responsible for detecting thermal stimuli of heat and cold (thermoreceptors), mechanical stimuli of touch, pressure, and stretch (mechanoreceptors), and finally pain (nociceptors) (Barrett *et al*., 2009; Stein *et al*., 2010).

Nociceptors are sensory neurons found throughout the human body capable of sending signals that cause the perception of pain through axons, which extend toward the peripheral nervous system in response to a potential or actual stimulus of tissue damage (Thrasher & Popovic, 2008). Their cell bodies are located in the trigeminal ganglionic chain and dorsal root ganglia (Rushton, 1997; Rushton, 2003; Thrasher & Popovic, 2008).

The triggering of nociceptors in electrical transmission occurs when the thresholds of chemical (potassium ions, bradykinin, serotonin, histamine, and proteolytic enzymes), and mechanical or thermal stimuli are overcome (Bender *et al*., 2013; Johnson, 2017). Some nociceptors are also called polymodal because they respond to more than one type of stimulus (Carraro *et al*., 2005; Salmons *et al*., 2005). The axons of nociceptors can be classified into two groups, the first with the presence of “Ad fibers” (A Delta), the latter presenting myelinated or myelinated fibers, thus composing the neospinothalamic tract, which in turn is capable of conducting an action potential of the order of 12 to 30m/sec towards the central nervous system, characterizing acute and well-located pain (Kern *et al*., 2004). And the second group, the “type C” axonal fibers: are unmyelinated, make up the paleospinothalamic tract, and are slower (0.5 to 2m/s), characterizing poorly localized and continuous pain (Peckham & Knutson, 2005).

In this sense, the literature points out that nociceptive pain can originate in two phases, the first phase being mediated by fast-conducting fibers, “Ad fibers” (sharp, extreme pain), and the second phase by slow-conducting fibers of type C (prolonged and less intense pain) (Rowe, 1992; Monaco *et al*., 2017; Mummolo *et al*., 2020). Acute painful sensations, as well as thermal and tactile sensations, converge on the thalamus, a sensitive interpretation network of pain (Chipaila *et al*., 2014). Some of the thalamus nuclei emit projections to the cerebral cortex, making awareness of the painful sensation possible (Mansourian *et al*., 2019). On the other hand, chronic pain originates from the impulses received by the slow pathway and is directed to the reticular formation and the Thalamus, characterizing the vague perception of pain. From the Thalamus, impulses are directed to the Cingulate Gyrus (affective or emotional quality of pain) and to the Somatosensory Cortex (type of pain, location, and emotional aspects) (Rowe, 1992; Monaco *et al*., 2017; Mummolo *et al*., 2020).

Different clinical conditions can be observed to trigger orofacial pain (Liu *et al*., 2013). In this sense, temporomandibular disorder gains notoriety, since it is characterized by a series of disorders that affect the temporomandibular joint (TMJ) and the muscles of mastication (Mohlin & Koop, 1978; Nakamura *et al*., 1983; Liu *et al*., 2013). This alteration has an etiology correlated with mandibular trauma, degenerative diseases, malocclusion, parafunctional habits, sleep disorders, and psychosomatic factors such as stress, anxiety, and depression (Dıraço?lu *et al*., 2016).

Anatomically, the TMJ is the movable and synovial joint that relates the mandible to the skull by means of an articular disc, being composed of the condyle of the mandible, which is located in the mandibular fossa and has its movement limited by the articular tubercle (Fulmer & Harms, 1989).

Myogenic pain in TMD is the most common form. However, there are other etiologies related to internal disorders in the joint, such as: dislocated or malpositioned joint disks (Ahmad & Schiffman, 2016; Graff-Radford & Abbott, 2016; Racich, 2018). Some of the signs and symptoms evidenced in clinical cases of TMD are a pain in the masticatory muscles, limitation of mouth opening, clicking, crackling, pain during mandibular movements, and pain in the head and neck region (Liu & Steinkeler, 2013; Gauer & Semidey, 2015).

The dental surgeon is the professional responsible for recognizing this condition and applying tangible knowledge to the neurophysiology of orofacial pain to correctly diagnose the different TMDs and to properly prescribe the therapy (Velly *et al*., 2013; Christidis *et al*., 2019).

Transcutaneous Electrical Nerve Stimulation (TENS). Transcutaneous electrical nerve stimulation (TENS) is nothing more than a procedure designed to relieve peripheral pain through non-painful impulses along the skin (Chellappa & Thirupathy, 2020). These discharges release endogenous analgesics and decrease patient discomfort (Fertout *et al*., 2022).

The transcutaneous electrical neurostimulation device is an effective, safe, and non-invasive method in the treatment of chronic and acute pain, avoiding the need to use medication (Mansourian *et al*., 2019). TENS devices are one of the most used resources in several areas, mainly in physiotherapy (Chipaila *et al*., 2014). However, some areas, such as dentistry, have used this complementary therapy as an essential therapeutic measure in the treatment of pain, whether related to TMJ disorders, joint dislocations, maxillomandibular stress, arthritis, back pain, neuralgia, cervical pain, tendinitis, cervicobrachial neuralgia, pain sciatica, neck pain, rheumatism, bone pain, back pain, sprains, dislocations, epicondylitis, postoperative pain, refractory pain, among others (Rowe, 1992; Monaco *et al*., 2017; Mummolo *et al*., 2020).

TENS is a technique that consists of applying electrical impulses to the skin through specific devices, these impulses, in turn, activate internal control mechanisms of the nervous system, exerting an analgesic action (Chipaila *et al*., 2014). In addition, they allow muscle stimulation, vasodilation, swelling reduction, and stimulation of the healing process of soft tissue injuries (Awan & Patil, 2015). It is interesting to clarify that this method does not generate dependence or addiction, thus preventing possible health risks and in most cases not causing side effects (Monaco *et al*., 2015).

Its physiological mechanism of analgesia depends on the modulation of the current applied to the affected region, that is, if low-frequency and high-intensity electrical impulses are applied, endorphins are released by the brain or spinal cord, which are substances with effects similar to morphine, thus leading to pain relief (Dowswell *et al*., 2009). If electrical impulses are applied with high frequency and low intensity, analgesia occurs due to a blockade of nerve pain signals that are not sent to the brain (Gerasimenko *et al*., 2015a). The application of TENS lasts from about 20 to 40 minutes, depending on the intensity of the stimulus, and can be done in an office by a qualified professional, or even at home. (Gerasimenko *et al*., 2015b).

In view of its numerous benefits, it is interesting to emphasize that this method should not be used by pregnant women or women who are breastfeeding, patients using a pacemaker or who have diseases involving the heart or skin regions close to the site. application (Bedwell *et al*., 2011; Keskin *et al*., 2012; Santana *et al*., 2016).

Current TENS is a non-invasive procedure widely used by professional physiotherapists in the conservative treatment of specific pain, it is an excellent option for very common complaints such as the case of TMD, the pathology has among its main causes involved in the muscles of the face with greater predominance in the muscular components of mastication, the main symptoms are pain, tinnitus, bruxism, crepitation and limitation of mandibular movement (Bender *et al*., 2013; Johnson, 2017).

Table I. Treatment modulation parameters according to the stage of the pathology.

CONVENTIONAL TENS (Acute Phase)	TENS BURST (Chronic Phase)	TENS ACUPUNCTURE (Chronic Phase)
Analgesia by the theory of pain gates:	Analgesia by release of beta-endorphins	Analgesia by release of cutaneous A-Delta afferents
Frequency - 50HZ to 100HZ	Frequency -1st 2HZ/ 2nd to 5HZ	Frequency-Lower than 10HZ
Pulse Width - 40us to 80us	Pulse Width -100 to 200us	Optimized Frequency -1 to 4 HZ
Analgesia time -20min to 2h	Time of analgesia – 10 to 30 minutes	Pulse width – 150 to 250HZ / Analgesia time – 30 minutes to 1 hour

TENS has its main objective to stimulate analgesia, its parameters are modulated in four functions, they are Conventional, Burst, Brief Intense and Acupuncture, the same is used in the acute phase of the injury and in the chronic phase, this current used to treat TMD is usually used in the critical phase where intense attacks of acute pain are the main symptoms (Lake, 1992; Macedo *et al*., 2015; Megía García *et al*., 2019; Manning *et al*., 2019).

In the acute phase of the injury, conventional TENS is used, in the chronic phase, Burt TENS is used (Ahmed *et al*., 2018) (Table I).

The application and positioning of the electrodes will depend on which area the professional will want to work on, usually, the involvement is in the region of the masticatory muscles, the negative electrode must be fixed in the larger region of the affected muscle, the positive must be positioned in the distal insertion of the musculature so that the specific region is stimulated (Lake, 1992; Macedo *et al*., 2015; Ahmed *et al*., 2018; Beckwée *et al*., 2018; Manning *et al*., 2019) (Fig. 1).

Fig. 1. Application of TENS in the muscle region of the masseteric fascia of the mandible.

Functional electrical stimulation (FES), Functional electrical stimulation (FES) is a form of treatment that uses low-frequency electrical current to cause contraction of paralyzed or weakened muscles resulting from upper motor neuron injury, such as strokes, spinal cord trauma or encephalic skulls, cerebral palsy, among others (Rushton, 1997; Popovic, 2014). This electrical current is specific in such a way that it enables functional muscle contraction, thus corresponding to its objective, the rehabilitation of the individual (Rushton, 2003).

The FES technique aims to contract the muscle fiber through electrical stimulation, which depolarizes the motor nerve, producing a synchronous response in all motor units of the muscle (Rushton, 1997; Rushton, 2003). This synchronism promotes an efficient contraction, but specific training is necessary in order to avoid early fatigue that would prevent the functional use of the method with rehabilitation purposes (Popovic, 2014).

In view of this, it is necessary to understand that it is not possible to obtain a functional movement of a paralyzed limb by a simple electrical pulse (Sharif *et al*., 2017). Therefore, a sequence of stimuli is necessary, on an appropriate frequency with a predefined duration (Moll *et al*., 2017). In some cases, it is necessary to carry out successive applications to achieve the rehabilitation objective (Rushton, 2003). Always observing whether the sequence of stimulus applications or pulse trains are present in the rest period, in order to avoid fatigue in the muscle reconditioning phase, in turn, allowing the control of muscle contractions and mandibular movements (Prenton *et al*., 2016).

The shape of the pulse train can be rectangular, but steeper ascent and descent phases allow a muscle contraction with more biological characteristics, if the pulse rise time is too slow, the nerve fiber undergoes a membrane accommodation process and can do not respond, despite the current intensity being adequate

(Peckham & Knutson, 2005). Therefore, in order to obtain an adequate functional recovery, the shape of the pulse trains and the individual characteristics of each pulse must be observed, in order to obtain satisfactory therapeutic effects (Kern & Carraro, 2014).

Motor action occurs appropriately when the external electrical impulse is not equal to the biological impulse that is made through the central nervous system (Kern *et al*., 2004). The literature demonstrates that the selective stimulation of type I and II fibers with different sizes and motor units, present similar excitatory responses, either with regard to quality and quantity of characteristics in muscle contraction or not in the selective activation of a certain type of fiber. (Carraro *et al*., 2005; Salmons *et al*., 2005). Therefore, motor units that are in the area of the electrodes also presented similar thresholds, when recruited simultaneously (Peckham & Knutson, 2005).

While fatigue settles in these tense muscle units, there is a tendency to reduce the impulse on the region (Thrasher & Popovic, 2008). On the other hand, when there is an increase in the intensity of the applied stimulus, recruiting new motor units with higher thresholds, or with similar thresholds but which are located further away from the electrodes, excessive fatigue is avoided, even if different parameters, be they frequencies, time application duration, excitatory stimulus, among others (Rushton, 1997; Rushton, 2003; Thrasher & Popovic, 2008).

In view of the aforementioned text on the FES, it is interesting to know that there are numerous indications in the field of dentistry, such as: neuromuscular facilitation; control of spasticity for muscles of the stomatognathic system; patients with facial paralysis; multiple sclerosis; muscular hypotrophy due to disuse and cerebral palsy (Barrett *et al*., 2009; Stein *et al*., 2010). As for its contraindications, they are mainly related to patients with a pacemaker axis; severe muscle spasticity; peripheral nerve injuries; electronic implants; area bone with altered sensitivity and patients refractory to electronic stimulation (Popovic *et al*., 2001). Functional electrical stimulation (FES) is a form of treatment that uses low-frequency electrical current to cause contraction of paralyzed or weakened muscles resulting from upper motor neuron injury, such as strokes, spinal cord trauma or encephalic skulls, cerebral palsy, among others (Rushton, 1997; Popovic, 2014). This electrical current is specific in such a way that it enables functional muscle contraction, thus corresponding to its objective, the rehabilitation of the individual (Rushton, 2003).

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As in the TENS current, the positioning of the electrodes is fixed on the muscles and their insertions, the parameters will be according to the patient's degree of need, this current is divided into the synchronous and reciprocal mode, with ramp contraction and relaxation time (Sivaramakrishnan *et al*., 2018).

Table II. FES current treatment modulation parameters.

FES Current Parameters	
Frequency	= Below 50HZ
Pulse width	= up to 25US
ON time	= 10 seconds
OFF time	= 10 seconds
Rise time	= 15 seconds
Descent Time	= 15 seconds.

The descent time (relaxation) should not exceed the rise time (contraction), the intensity parameter will depend on the patient's support (Rushton, 1997) (Fig. 2).

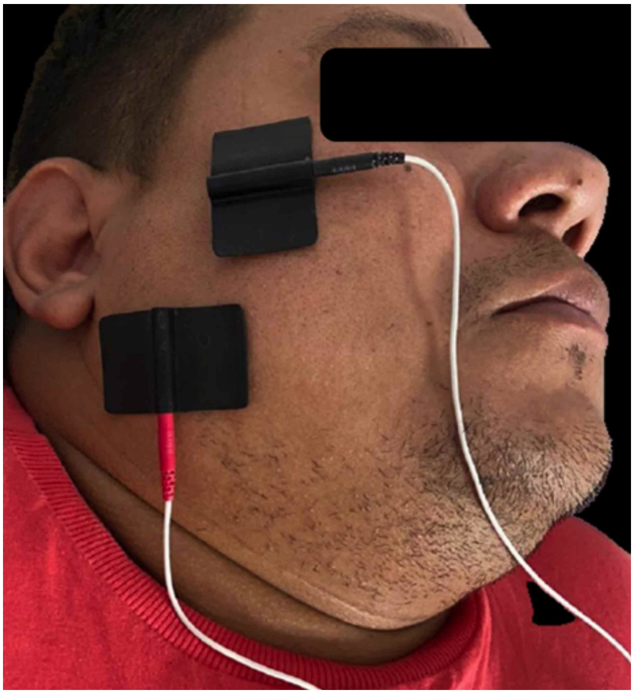

Fig. 2. Functional electrostimulation (FES) activity, resulting in minimal contraction of the masticatory muscles, resulting in a rehabilitation process of the functional disorder.

Dry needling. Dry needling is a therapy that consists of applying acupuncture needles directly to trigger points formed in the muscle fiber (Cummings & White, 2001; Vier *et al*., 2019). These points, resulting from injuries caused by day-to-day tensions, these stresses are mainly related to sudden and excessively fast movements, falls, ischemia, inflammation, absence or excess of physical exercises, emotional stress, nutritional deficiencies, and changes in posture (Tough *et al*., 2009; Machado *et al*., 2018).

The formation of nodules, which are palpable through the fingertips, is caused by excessive stretching or shortening of the muscle fiber, which contracts excessively, to the point of preventing progressive relaxation (Ong & Claydon, 2014; Liu *et al*., 2018). Therefore, the oxygenation of the region becomes deficient due to poor blood circulation, causing pain (Turo *et al*., 2015; Aksu *et al*., 2019). In this sense, needling acts by stimulating the release of opioid substances (enkephalin and serotonin) by the body itself, controlling the individual's sensation of pain (Kietrys *et al*., 2014; Cagnie *et al*., 2015). In turn, stimulates the central and peripheral nervous system to release neurotransmitters that favor the process of restoring and maintaining health (Ibuldu *et al*., 2004; Tesch *et al*., 2021).

Dry needling treatment management aims to act specifically on myofascial trigger points (Fernández-Carnero *et al*., 2010; Lu *et al*., 2020). The literature demonstrates that the excessive release of acetylcholine from muscle motor endplates promotes the progressive relaxation of the structure under tension (Simons & Mense, 2003). Furthermore, it is worth elucidating that the formation of trigger points is caused by the creation of a stretched band in the muscle, thus, the excessive release of acetylcholine from the motor endplate combined with the inhibition of acetylcholinesterase and increase of nicotinic acetylcholine receptors (Kalichman & Vulfsons, 2010; Leggit, 2018; Lu *et al*., 2020).

Initially taut muscle bands are produced as a normal protective physiological measure in the presence of actual or potential muscle damage (Furlan *et al*., 2010). They are thought to occur in response to unaccustomed eccentric or concentric loading, sustained postures, and low-load repetitive stress (Cox *et al*., 2016). However, when held, they contribute to sustained pain, this being pain caused by trigger points due to hypoxia and decreased blood flow within the trigger point, leading to a decrease in pH, which activates muscle nociceptors to restore normality. homeostasis, causing peripheral sensitization (Dalewski *et al*., 2019; Lu *et al*., 2020).

The mechanism remains unclear, but trigger points maintain nociceptive input to the dorsal horn and therefore contribute to central sensitization (Al-Moraissi *et al*., 2020; Lu *et al*., 2020). In some cases, trigger points can generate hyperalgesia, which is an increased sensitivity to pain and is often the result of damage to nociceptors or peripheral nerves (Segura-Pérez *et al*., 2017). For example, trigger points in the muscles of the shoulder, neck, and face are a common source of headaches because the trigger point refers to pain in the head (Lu *et al*., 2020).

It is interesting to elucidate that these muscle pain generators can be divided into active and latent myofascial trigger points (Gerber *et al*., 2017; Lu *et al*., 2020). Actives can spontaneously trigger local or referred pain (Gerber *et al*., 2015). In turn, causing muscle weakness, movement restriction, and autonomic phenomena (Gerber *et al*., 2015, 2017). Latent ones, on the other hand, do not cause pain unless they are stimulated, so when changes in muscle activation patterns occur, it triggers a contribution to the decrease in the range of motion (Dommerholt *et al*., 2018).

Trigger points can develop during occupational, recreational, or sporting activities when muscle use exceeds muscle capacity and normal recovery is disrupted (Gerber *et al*., 2017; Lu *et al*., 2020). Given this, the dry needling technique appears as an excellent treatment tool, since this therapy focuses on stimulating these trigger points and releasing tension in order to relieve pain (Brignardello-Petersen, 2019).

The mechanism of action of dry needling occurs through the mechanical blockade of the dysfunctional motor plate resulting in a local contraction response, the local contraction response promotes a change in the length of the muscle fiber, in addition to allowing the inhibition of pain on the antagonistic muscles (Al-Moraissi *et al*., 2020; Lu *et al*., 2020). This technique mainly involves using a fine filiform needle to penetrate the skin and stimulate underlying myofascial trigger points, muscle and connective tissues in order to relieve pain and movement problems (Segura-Pérez *et al*., 2017).

In view of the aforementioned text, we can highlight that there are countless pathologies that are related to trigger points, including myofascial pain syndrome; tension-type headaches; migraines; temporomandibular joint pain; muscle pain from exercise; overtraining pains; complex regional pain syndrome; phantom pain (Ma *et al*., 2010; Segura-Pérez *et al*., 2017). In this situation, dry-needling therapy is used as an excellent alternative for reducing and restoring deficiencies in body structure and function, leading to better activity and participation of the living organism (McMillan *et al*., 1997; Segura-Pérez *et al*., 2017). In addition, it promotes a reduction in pain, re-establishment of the movement process, and a high capacity to accelerate the tissue repair process that these pathologies present (Goddard *et al*., 2002).

Final considerations

It can be concluded from this study that: Evidence-based healthcare has made great advances in recent decades, especially in the areas of orofacial pain, TMD, and occlusion, especially related to orthodontic, prosthetic, and restorative care. Dentists are encouraged the constantly search for new information in the literature as treatment tools. Therefore, multidisciplinary care becomes a practical reality for dental teams that adopt integrative health care models. Complete and structured involvement and assessments of the whole patient, whether with differential diagnoses and labor management and personalized treatment strategies and implementation are important for an effective outcome, and an improvement in the individual's quality of life.

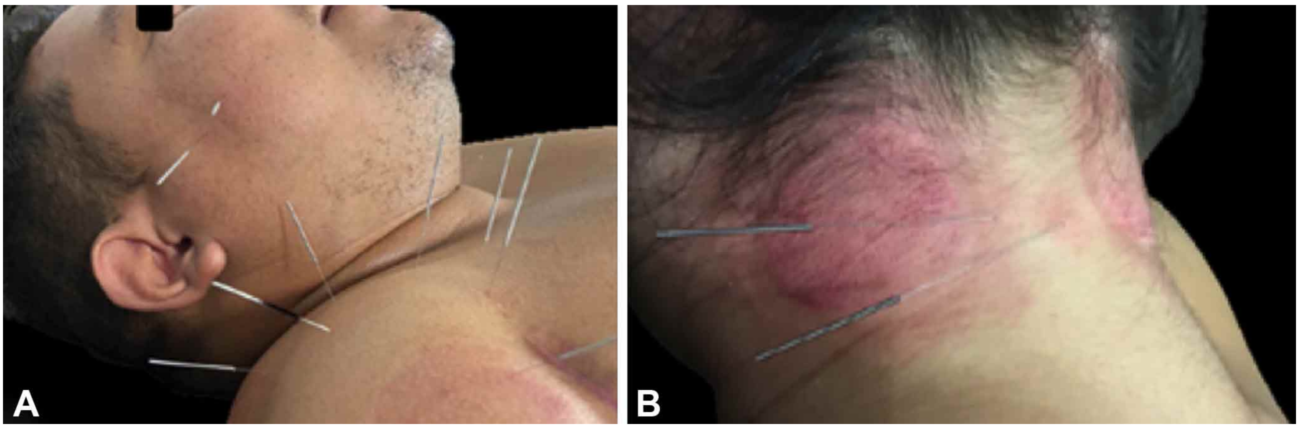

Fig. 3. Illustrative image of a patient with TMD, in which the main complaint is tension in the lateral region of the muscles of the face, upper part of the shoulder, neck and cervical region. A) Dry needling procedure being used as treatment management for progressive relaxation of the masseter muscle, zygomaticus, anterior and middle deltoid fibers, upper trapezius fibers. B) Dry needling of the accessory muscle, middle and lower posterior fibers, stimulation of the sternocleidooccipitomastoid muscle, with procedure time between 10 and 25 minutes depending on the symptomatic degree of the individual.

MATOS, J. D. M.; QUEIROZ, D. A.; ALCÂNTARA, M. A. S.; MOURA DOS SANTOS, A. C.; DE VASCONCELOS, J. E. L.; LOPES, G. R. S.; BOTTINO, M. A. & ANDRADE, V. C. Conocimientos, actitudes y prácticas sobre nuevas modalidades de tratamiento de las disfunciones tempomanibulares y el dolor orofacial. *Int. J. Odontostomat., 17(2)*:142-154, 2023.

RESUMEN: En el presente estudio se propuso describir, a través de una revisión bibliográfica, el uso de nuevos manejos terapéuticos que permitan brindar una mejor calidad de vida a los individuos afectados por estas patologías. Se realizó una búsqueda bibliográfica en las principales bases de datos de salud PUBMED (www.pubmed.gov) y Scholar Google (www.scholar.google.com.br), en las que se recopilaron estudios publicados entre 1987 y 2023. En la primera etapa, se examinó la lista de artículos recuperados mediante la lectura de los títulos y resúmenes. En la segunda etapa, los estudios fueron seleccionados mediante la lectura del contenido completo. Dos autores (JDMM y DAQ) realizaron las etapas 1 y 2. Se incluyeron estudios de cohortes experimentales, clínicos, de casos y controles, controlados aleatorios y de laboratorio, informes de casos, revisiones sistemáticas y revisiones de la literatura, que se desarrollaron en individuos vivos. Por lo tanto, se excluyeron artículos que no trataran el tema en cuestión, cartas al editor, artículos de opinión, literatura duplicada en bases de datos y literatura que no abordara las variables en estudio. La odontología contemporánea utiliza tratamientos alternativos capaces de mejorar el estado del paciente, ya que no siempre es posible la curación. Por lo tanto, la posibilidad de mejorar la calidad de vida se convierte en un objetivo importante. La atención médica basada en la evidencia ha logrado grandes avances en las últimas décadas, especialmente en las áreas de dolor orofacial, TMD y oclusión, especialmente en relación con la atención de ortodoncia, prótesis y restauración.

PALABRAS CLAVE: articulación temporomandibular, trastornos de la articulación temporomandibular, dolor facial; oclusión dental, investigación dental.

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