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The use of dry needling in the treatment of cervical and masticatory myofascial pain

O emprego do agulhamento seco no tratamento da dor miofascial mastigatória e cervical

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ABSTRACT

BACKGROUND AND OBJECTIVES: Dry needling is an interventionist, minimally invasive technique, used in the treatment of myofascial pain. The objective of this study was to describe the use of dry needling and to perform a critical literature analysis about the technical aspects of its use by qualified health care professionals.
CONTENTS: A search in the literature was carried out for books in English, review articles, randomized controlled or quasi-randomized clinical trials, blind or double-blind and published case studies series in Portuguese or in English. The following databases were used: Cochrane, LILACS, and Pubmed. Articles published from September 1996 to January 2017 were selected according to the following keywords: dry needling *versus* myofascial pain syndrome *versus* temporomandibular joint dysfunction syndrome) *versus* trigger points *versus* musculoskeletal manipulations *versus* trapezius muscle, superficial back muscles *versus* masseter muscle *versus* secular muscle *versus* pterygoid muscles *versus* digastric muscle, neck muscles. Reports of clinical cases, "open-label" studies, studies with animal models and articles not related to DN were excluded. After the matching descriptors and the implementation of inclusion and exclusion criteria, we selected six articles.
CONCLUSION: The diagnosis of myofascial pain can be a difficult task since it can simulate different masticatory system pain, from a toothache to a trigeminal neuropathic pain. This can be minimized with proper history taking, clinical examination involving muscle palpation, as well as the own experience and professional training. The deactivation of myofascial trigger points should be a priority in myofascial pain therapy since there is a significant improvement of local and referred pain when we use this approach. Despite the favorable results of studies about the use of dry needling in myofascial pain treatment related to temporomandibular joint dysfunction and the cervical region, the literature still lacks studies with a high level of evidence proving the effectiveness and efficacy of this technique. This is a minimally invasive, low cost, and safe therapy that provides local, segmental, extra segmental and placebo effects. Therefore, its use should be recommended by different health professionals in cases of myofascial pain.

Keywords: Dry needling, Myofascial pain syndrome, Myofascial trigger points, Temporomandibular joint dysfunction.

RESUMO

JUSTIFICATIVA E OBJETIVOS: O agulhamento seco é uma técnica intervencionista, minimamente invasiva, utilizada no tratamento da dor miofascial. O objetivo deste estudo foi descrever o emprego do agulhamento seco e realizar a análise crítica da literatura sobre os aspectos técnicos de sua utilização por profissionais capacitados da área da saúde.
CONTEÚDO: Foi realizada uma busca na literatura por livros em inglês, artigos de revisão, estudos clínicos controlados randomizados ou quase-randomizados, encobertos, ou duplamente encobertos e estudos de séries de casos publicados em português ou inglês. Foram utilizadas as seguintes bases de dados: Cochrane, LILACS e Pubmed. Foram selecionados artigos publicados no período de setembro de 1996 a janeiro de 2017, recrutados após a utilização dos seguintes descritores: agulhamento seco *versus* síndromes da dor miofascial *versus* síndrome da disfunção da articulação temporomandibular *versus* pontos-gatilho *versus* manipulações musculoesqueléticas *versus* músculo trapézio (superficial back muscles) *versus* músculo masseter *versus* músculo temporal *versus* músculo pterigoideo *versus* músculo digástrico. Foram excluídos relatos de casos clínicos, estudos abertos "open-label", estudos em modelos animais e artigos não relacionados ao agulhamento seco. Após o cruzamento dos descritores e aplicação dos critérios de inclusão e exclusão, foram selecionados seis artigos.
CONCLUSÃO: O diagnóstico da dor miofascial pode se apresentar como uma tarefa difícil, uma vez que ela pode simular diferentes algias do sistema mastigatório, desde uma odontalgia até uma dor neuropática trigeminal. Isso pode ser minimizado com uma adequada anamnese, exame clínico envolvendo palpação muscular, além da própria experiência e treinamento profissional. A desativação dos pontos-gatilho miofasciais deve ser prioridade na abordagem terapêutica da dor miofascial já que é observada melhora significativa da dor local e referida, quando essa é realizada. Apesar de resultados favoráveis em estudos sobre

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o agulhamento seco no tratamento da dor miofascial, relacionada à disfunção temporomandibular e a região cervical, ainda faltam na literatura pesquisas com elevado nível de evidência que comprovem a eficácia e a eficiência dessa técnica. Essa é uma terapia minimamente invasiva, de baixo custo, segura e apresenta efeitos locais, segmentares, extrassegmentares e placebo. Diante do exposto, pode-se recomendar seu emprego por diferentes profissionais da área da saúde nos casos da dor miofascial.
Descritores: Agulhamento seco, Disfunção da articulação temporomandibular, Pontos-gatilho miofasciais, Síndrome de dor miofascial.

INTRODUCTION

Dry needling (DN), used for myofascial pain (MP) treatment, despite being taken for traditional Chinese acupuncture, is a western technique based on distinctive neurophysiologic principles. First described by Travell in the 1960s, DN was largely used after Lewits' studies were published and widespread in the last decade[1,2]. DN was originally developed in order to disable myofascial trigger points (MTrPs). A myofascial trigger point is a hyperirritable spot, located within a taut band of muscle, or muscular fascia, associated with local or referred pain. They are also associated with clinical signs of MP and a source of peripheral and central sensitization[3,4].

Besides being closely linked to MP physiopathology, the MTrPs are connected to muscle weakness, local irritability, muscle unbalance and lack of motor coordination on the affected muscle or the groups pertaining to its synergy[5,6].

Wrigth e North[7] have studied 190 patients suffering from temporomandibular pain, in order to demonstrate which masticatory and cervical muscles connected to temporomandibular dysfunction (TMD) are more affected and more capable of generating pain in the craniofacial area. They found the prevalence of the superior trapezius muscle in 60% of the patients, the lateral pterygoid in 50% and the masseter, superficial bundle, in 47%.

Another epidemiological study, conducted by Fernández-de-las-Penas et al.[8] investigated the number, location and reference area of active MTrPs pain in the superior trapezius, head splenius, sternocleidomastoid, masseter, superior oblique, levator scapulae and suboccipital muscles in 13 women, 30 and 50 years old, with tension type cephalalgia. An average of seven active trigger points (AMTrPs) was found in each patient with the following location prevalence: suboccipital muscles (92%), superior oblique muscle (85%), superior trapezius muscle (85%) and masseter muscle (69%). The largest pain reference area by AMTrPs was the forehead (5.9 cm^2), followed by the occipital (4.1 cm^2), lateral left (3.3 cm^2) and right (2.8 cm^2) areas.

The objective of this study was to describe the use of DN and to perform a critical literature analysis about the technical aspects of its use by qualified health care professionals.

THEORETICAL MODELS

In the last 30 years, several methods and conceptual models concerning DN have been developed. The most used MTrPs model in clinical practice proposed by Simons, Travell and Simons[9], proposes that needling should be performed directly on the active and latent MTrPs since they are assumed as an MP[1] hegemonic factor. The DN is intended to cause an effect known as "rapid contraction response" (RCR), which features a spinal reflex, resulting from the sudden and involuntary contraction of the muscle fibers present in the stressed muscle band, which contains the MTrPs[9,10]. This effect is considered necessary in this model so that the technique is effective and when touched, it indicates the needle was inserted correctly[11,12].

Gunn[13], one of the ND use pioneers, from empirical observations, proposed a model called "Radiculopathy." In this model, the needle is inserted in the paraspinal area (mainly in the multifidus muscles) related to the peripheral muscles and in the muscle tendon junction which contains the MTrPs. The same author has based his technique on the principle that considers the MP as a syndrome caused by a neuropathy or peripheral radiculopathy. This syndrome features neurophysiologic changes in the spinal nerve emerging area, associated with disc compressions, narrowing of intervertebral foramen and nerve compression. These changes can be associated with muscular malfunction, with the resulting emergence of MTrPs in muscles innervated by the affected root[6,11,13].

The spinal segmental sensitization model was proposed by the physiatrist Fischer[14]. In this case, the needling is made in the interspinous and supraspinous ligaments, in the paravertebral muscles and directly in the MTrPs. According to this model, the segmental sensitization results in a hyper activation of the medullary dorsal horn by nociceptive stimulus originating from the wounded tissue. This results in hypersensitivity in the dermatomes and painful activation of the corresponding sclerotomes, besides the generation of MTrPs in the muscles connected to that spinal level[3,11,12,15].

MECHANISM OF ACTION AND PHYSIOLOGICAL EFFECT

The effects of reduction of pain and muscle stress, coordination and muscle length improvement, besides recovery of mobility due to DN, are very complex and are associated to MTrPS disinhibition. Therefore, we will begin with describing the physiopathology of the trigger points (TP) build up and later the mechanisms that explain the effects of the DN grouped into local, segmental and extra segmental, according to the most recent literature. These effects differ depending on the location, depth, and movement of the needle, and also whether the RCR is present or not.

MYOFASCIAL TRIGGER POINT

The MTrP can objectively be observed in nuclear magnetic resonance (NMR) exams, ultrasound scan (US)[1] and infrared thermography (IRT)[16,17]. The first two exams are difficult to use in regular practice due to their high cost, while the IRT equipment is not normally available on specialized services and hospitals. In the face of that, it must be identified by manual touching or by rolling or pinching techniques to find the muscles, their synergistic and their antagonists[1,6]. After identification, the MTrPs can be qualified into three subtypes: active, latent and satellite, the two first ones being the most used in the ND therapy. The active MTrP is spontaneously painful, producing a pain pattern from a distance. The latent usually triggers pain only after the stimulus, while the satellite results from primary TrPs (latent or active) present during long periods of time[9,15,18].

PHYSIOPATHOLOGY OF THE MYOFASCIAL TRIGGER POINT

According to recent research, there are three essential factors involved in the MTrP generation: excessive release of acetylcholine, shortening of sarcomeres and release of inflammatory and algogenic substances like, for example, substance P. Increase of acetylcholine at the neuromuscular joint causes increase of muscle fiber tension and, consequently, localized ischemia and hypoxia which induce release of algogenic substances (energy crisis). These substances cause higher release of acetylcholine completing a vicious cycle[2,18,19]. Maintaining harmful stimulus gradually increases sensitization of the medullary dorsal horn and neurons, which were silent, start sending ascending stimulus, activating supraspinal systems which result in central sensitization[18-20].

LOCAL EFFECTS

Inserting the needle in the MTrP harms and/or destroys the motor plates with the resulting distal axonal denervation and inducing physiological regeneration after 7 to 10 days. This lesion is focal and does not bring a significant risk of generating scar tissue[6,11].
The RCR, when obtained, reduces electric activation of the affected motor plate (by reducing the excessive action of acetylcholine), which is observed by the spontaneous reduction of electrical activity in the tension band zone[21].
Another probable local effect is the stretching of the cytoskeleton structures, followed by the recovery of the sarcomeres normal length due to the reduction of the overlap of the actin and myosin filaments[6,20].
The mechanical pressure induced by the needle associated with its rotation polarizes the conjunctive tissue, which has an inherent piezoelectricity feature. This mechanical stress transformed into electrical activity seems to help tissue remodeling[6].
When the needle is inserted, an axonal reflex hits the terminal net of A delta and C fibers, which are connected to the release of several vasoactive substances[6,19,20]. They act generating vasodilatation and increase of local blood flow which results in reducing the concentration of algogenic substances and reducing the activation of nociceptors, reaching the point of resolution of peripheral sensitization[18]. Besides local vasodilatation, a study using a thermographic camera has shown distal vasodilatation in the pain reference area[21,22].

SEGMENTAL EFFECTS

Inserting the needle awakes A delta and A beta fibers present in muscles and skin, which in turn activate intermediate cells like dorsal in the spinal medulla, by collateral terminals. The intermediate cells release enkephalin which blocks the transmission of pain, effect known as "segmental analgesia," which requires a few seconds to begin but can last several days[23].

EXTRA-SEGMENTAL EFFECTS

O DN activates the release of opioid neuropeptides such as beta-endorphins, enkephalin and dynorphin. These opioids can work by inhibiting directly the ascendance of the nociceptive transmission which began in the medullary dorsal horn. The beta-endorphin released after needling originates a suppression in the release of substance P, also inhibiting the transmission of pain[2,4]. These peptides also activate an area in the mesencephalon, the periaqueductal gray substance (PAG), where several fibers descend from each spinal medullary level to the dorsal horn. The PAG is activated by beta-endorphin which is released by the nerve fibers descending from the hypothalamus (more precisely from the arcuate nucleus). The system descending from PAG releases serotonin which makes the intermediate cells to release enkephalin, which, in turn, inhibits the spinal dorsal horn cells, blocking the transmission of pain. Another descending PAG via originates diffuse release of noradrenaline all over the dorsal horn, generating a post-synaptic inhibitory block of the transmission cells (Figure 1)[23].
A delta fiber stimulation seems to activate descending inhibitory systems mediated by a synergistic relationship between serotonin and norepinephrine. Norepinephrine has a direct inhibitory effect on the post-synaptic membrane of the transmission cells[2].

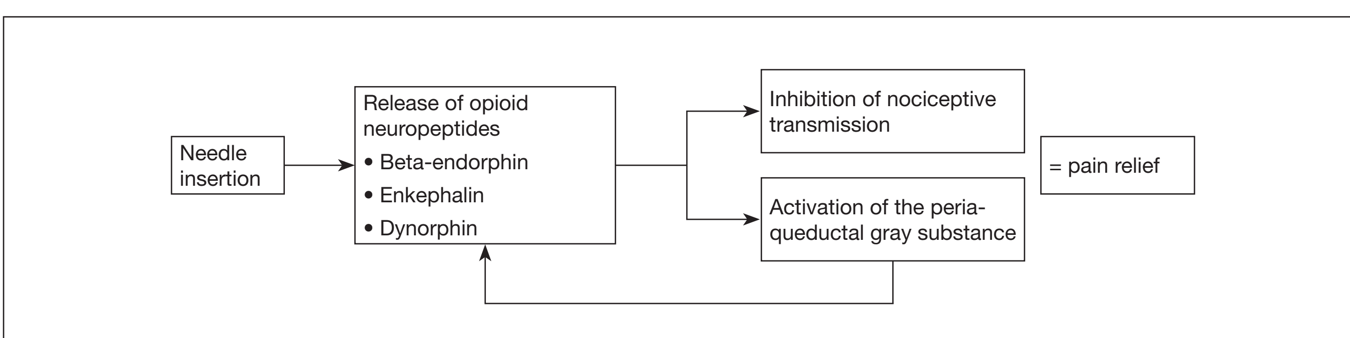

Figure 1. Extra-segmental effects

More recent studies indicate that DN increases the number of opioids via endocannabinoid system[2]. These cannabinoids can inhibit the release of several pro-inflammatory cytokines reducing pain and inflammation.

PLACEBO EFFECT

The expectation generated by therapeutic procedures is capable of modulating the perception of pain, a mechanism known as "placebo analgesia"[16]. Neuroimaging showed that brain areas such as the periaqueductal gray substance, amygdala, insula, and thalamus are recruited during the placebo analgesia. Therefore, these effects are enhanced when the ND[4] technique is used.

APPLICATION TECHNIQUE

DN can be used with deep (DDN) and superficial (SDN) technique. In DDN, the needle is inserted through the skin and goes deep towards the center of the MTrPs. When the RCR signal is provoked, the technique seems to be more effective, probably due to the rapid depolarization of the muscle fibers involved, associated to the reflex contraction[12].

The conclusion of a recent[2] review study was that the RCR is not a crucial component in the treatment. The DDN reaches the polymodal receptors of the motor units, and studies suggest that these receptors are more effective in inducing analgesia than cutaneous receptors[12,23]. These receptors respond to chemical, thermal and mechanical stimulation and can generate effective analgesic effects when stimulated by needling. DDN is associated with the reduction in the activation of the terminal motor plates involved in reducing local and referred pain, increasing movement amplitude and reducing the concentration of inflammatory substances present in the location of the MTrPs[20,24,25].

It can be performed by using different methods of inserting the needle. In the stationary technique, the needle is inserted in the desired location and kept with no other manipulation. In the piston-like type, the needle is inserted and partially removed several times in the selected spot or around it. Another application method is to perform needle rotations, both clockwise and counter-clockwise, keeping it in the same spot. This rotation seems to activate more precisely the C fibers and the superficial and deep receptors when compared to the piston-like type[2]. Piston-like type is believed to be more effective in inducing local relaxation of the muscle fibers. However, it is associated with a higher number of adverse effects[2]. The stationary type seems to be more effective as analgesia[12,24,26]. Despite these considerations, the studies are not conclusive as to which is the more effective approach.

In SDN, the needle is inserted in the MTrPs, into the subcutaneous layer, 5 mm to 10 mm deep, at an angle between 20 and 30°. The needle can be kept fixed on the spot or be rotated. Since it isn't inserted into muscle tissue, RCR is not expected. SDN has the benefit of being less painful than DDN, besides being indicated for application in risky areas such as lungs and large blood vessels. Studies have shown that SDN is more effective than the placebo in reducing painful situations[12].

Either DDN or SDN can be used in muscles in a distal position in relation to the active MTrPs on the same dermatome[3]. The resulting analgesic and sedative effect can be explained by the diffuse nociceptive inhibitory control phenomena. This needling technique can be selected if the main area to be treated is very sensitive (hyperalgesia and/or allodynia).

APPLICATION TIME AND FREQUENCY

Studies are non-conclusive as to how long the needle should be in place with either technique, and there is no consensus as to how many sessions would be necessary. Clinical practice indicates it can last from 5 up to 30 minutes[4]. Some authors indicate 2 to 3 sessions for acute cases and 3 to 5 sessions for chronic cases[1].

CONTRAINDICATIONS

The ND absolute contraindications are needle phobia, areas with lymphedema, medical urgency, history of abnormal reaction to anesthetic procedures and unconsciousness, or mental confusion. The relative contraindications are therapy with anticoagulant, vascular disorder, epilepsy, allergy to the metal on the needle, pregnancy and in children[1,11].

CONTENTS

Search strategies in literature

In order to make a critical review of the scientific evidence on the use of ND to control masticatory and cervical muscle pain, a search in the literature was carried out for books in English, review articles, randomized controlled or quasi-randomized clinical trials, blind or double-blind and published case studies series in Portuguese or in English. The following databases were used: Cochrane, LILACS, and Pubmed. Articles published from September 1996 to January 2017 were selected according to the following keywords: dry needling versus myofascial pain syndrome versus temporomandibular joint dysfunction syndrome) versus trigger points versus musculoskeletal manipulations versus trapezius muscle, superficial back muscles versus masseter muscle versus temporal muscle versus pterygoid muscles versus digastric muscle, neck muscles. Reports of clinical cases, "open-label" studies, studies with animal models and articles not related to DN were excluded.

After the matching descriptors and the implementation of inclusion and exclusion criteria, we selected six articles, with results summarized below:

Dry needling on myofascial trigger point in the cervical area

Ong and Claydon[27] in their systematic review study, with meta-analysis, meant to determine ND efficiency, as compared to other techniques (needling with lidocaine and placebo) to treat MTrPs, in the cervical and shoulder areas. The visual analogue scale (VAS) was the rating instrument selected to measure the pain in these patients. It was used at the beginning of the treatment, right after the end and 1 to 6 months later. AMTrPs were found in the superior trapezius muscle in all the studies, but there was no reference as to which ND technique was used and if it was applied in other AMTrPs in the analyzed areas. The conclusion was that ND is as effective as the use of lidocaine in the active MTrPs and points out that the first is minimally invasive, low cost and has less adverse effects than the local anesthetic. They have also mentioned there is no difference between ND and the placebo.

Ziaeifar et al.[28] conducted a randomized study with 33 patients which also presented MTrPs in the superior trapezius muscle. The patients were divided into a standard group (n=17) and an experimental group (n=16). The first group received the digit pressure therapy in the MTrPs and the second group, dry needling (DN) using the piston-like type. They were submitted to 3 sessions for a one-week treatment. The VAS and the algometer were used before and after each procedure to measure pain intensity and the pain threshold to pressure. The measurements were taken again, 2 days after the end of the 3rd session. The results of this study suggest that both the digit pressure and the ND were effective to relieve pain and increase the pain threshold to pressure. However, the difference in the VAS measure in the group receiving ND was significantly higher. According to the study, this can be explained by the higher blood flow and local oxygenation promoted by DN.

Pecos-Martín et al.[29] observed in a randomized research with 73 patients with unilateral cervical pain, that the patients submitted to DN on the active MTrPs of the inferior trapezius muscle, presented significant pain relief, increase of pain threshold to pressure and reduced incapacity rate when compared to patients submitted to needling in the same muscle, but at a distance 1.5 cm farther from the active MTrPs.

Dry needling on myofascial trigger point in the masticatory muscles

Fernándes-Carnero et al.[30] researched the effects of DDN, compared to the placebo (false superficial needling) in 12 female patients com TMD, myofascial pain type. The DDN and the placebo were performed in the active MTrPs of the masseter muscle, in 2 sessions 2 days apart. An electronic algometer was used to measure the pain threshold to pressure before the intervention, after 5 minutes and 1 week later. The maximum mouth opening without pain was measured the same way. The technique used in the DDN was piston-like, performed in the active MTrP of the masseter muscle, up to 5 rapid contraction responses (RCR). The conclusion was that the DDN in the masseter was more effective in raising the pain threshold to pressure and gain mouth opening amplitude without pain, although the group receiving placebo also had an improvement in the measurements.

After confirming that masseter and anterior temporal muscles are the most commonly affected with masticatory myofascial pain, other authors[31] conducted a randomized, double-blind study comparing the DDN technique and the placebo needling (Sham) in the active MTrPs of those muscles. The study included 52 subjects (45 women and 7 men) with ages varying from 18 to 57 years, divided into a study and a control group. The study group was submitted to 3 sessions, one every 7 days, when the active MTrPs received the DDN using the piston-like technique. The VAS and the pressure algometry were applied immediately after the 1st intervention and again a week after the last intervention. The study results pointed to pain reduction and an increase in pain threshold to pressure in both groups. Other studies already mentioned have also pointed there was no difference between the NND technique and the Sham needling (superficial).

Gonzalez-Perez et al.[32] conducted a study with 48 patients who had chronic masticatory myofascial pain, with the involvement of the lateral pterygoid muscle. This muscle, selected because it is difficult to reach for the application of other techniques such as stretching and deep massage, received the DN via extraoral in the test group (n=24). There were 3 sessions, once a week, totaling 3 weeks. The control group was submitted to pharmacological therapy with methocarbamol/paracetamol prescribed every 6 hours, for 3 weeks[33]. The VAS and the movement amplitude measurements, such as maximum mouth opening, laterality, and protrusion of the mandible were measured at the beginning and the end of the treatment. The authors reached the conclusion that the ND was more efficient for reducing pain and recovering the amplitude of the measured movements than the group pharmacologically treated.

CONCLUSION

The diagnosis of myofascial pain can be a difficult task since it can simulate different masticatory system pain, from a toothache to a trigeminal neuropathic pain. This can be minimized with proper history taking, clinical examination involving muscle palpation, as well as the own experience and professional training. The deactivation of myofascial trigger points should be a priority in myofascial pain therapy since there is a significant improvement of local and referred pain when we use this approach. Despite the favorable results of studies about the use of dry needling in myofascial pain treatment related to temporomandibular joint dysfunction and the cervical region, the literature still lacks studies with a high level of evidence proving the effectiveness and efficacy of this technique. This is a minimally invasive, low cost, and safe therapy that provides local, segmental, extra segmental and placebo effects. Therefore, its use should be recommended by different health professionals in cases of myofascial pain.

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