● PERSPECTIVE

Laser therapy on points of acupuncture on nerve repair

Paresthesia is the name given to a temporary or permanent sensory loss caused by several surgical procedures that affected the peripheral sensory nerve. In dentistry, common iatrogenic procedures that can lead to sensory loss include third molar removal, blocking of the inferior alveolar nerve (local anesthesia), orthognathic surgery, implant placement, surgical removal of cysts or tumors and facial trauma.

To facilitate the understanding and severity of injuries on the sensory nerve fibers, the classification proposed by Seddon (1942) and Sunderland (1951) are widely used. Seddon classified the neural damage as neuropraxis (first degree of Sunderland's nerve injury); axonotmesis (second degree of nerve injury) and neurotmesis (third, fourth and fifth degree of Sunderland's nerve injury). In cases in which only nerve compression after post-traumatic edema (neuropraxis) occurs, no intervention is indicated because the nerve sensitivity will gradually and spontaneously return. If there is no positive result, it is recommended the use of steroids or surgical decompression. However, in cases in which neural section occurs, neurorraphy techniques are recommended to restore the nerve's sensory and/or motor function loss. However, neurorraphy is performed only in cases where there was nerve laceration, nerve transection, the formation of a neuroma, pain caused by a strange object or progressive increase in sensory loss.

Recently, the therapeutic use of low power lasers has been proposed (de Oliveira et al., 2015a) for peripheral sensory nerve repair. The therapy was first described in 1978 and since then low-power lasers have been widely studied and major advances have been made over the last decades.

Laser therapy promotes photochemical, photophysical and photobiological effects by releasing photons that are absorbed by the cells at the target tissue (de Oliveira et al., 2015a). Effects of the laser phototherapy at cellular level have been well elucidated, corresponding to the stimulation of mitochondrial activity, stimulation of RNA and DNA synthesis, variation of intracellular and extracellular pH, increasing the metabolism with increased protein production, and modulation of enzymatic activity (Karu, 2010).

Studies have shown that laser therapy provides immediate protective effects that enhance the functional activity of the damaged nerve and benefits nerve functional activity over time. Moreover, it can positively influence the tissue healing and prevent or reduce the degeneration of neural tissues (de Oliveira et al., 2015a). Low power lasers work by decreasing inflammation and, as a consequence, sensitivity to pain (Karu, 2013). It also stimulates circulation and cellular activity (biomodulation), with potential to increase mitochondrial ATP production, and may cause an increase in the excitability threshold of free nerve endings resulting from the analgesic effect (de Oliveira et al., 2015a). The mechanism by which low power lasers act is based on their ability to stimulate the pump Na^+/K^+ in the cell membrane (Karu, 2010). This stimulation hyperpolarizes the membrane, increasing nerve impulses and the pain threshold. The analgesic effect still occurs due to the increase of β-endorphin in the cephalorachidian fluid. Other effects on inflammatory processes and wound healing have also been attributed to use low-power lasers, which are capable of inducing a capillary arteriolar vasodilation and vascular neoformation, leading to increased blood flow in the irradiated area (Karu, 2013).

Another therapy currently used for the treatment of paresthesia is the laser therapy on points of acupuncture (laser acupuncture), which follows the principles of traditional Chinese medicine (de Oliveira et al., 2015b). Laser acupuncture is defined as the stimulation of traditional acupuncture points with low power lasers (infrared wavelength), with no thermal effects on the target tissue. Laser irradiation is done transcutaneously to a single, anatomically defined acupuncture point, many of which overlie the course of peripheral nerves. Differently from the laser therapy – in which the energy emitted by the light affects the metabolic processes of the target cells (biomodulation) – laser acupuncture is reported to affect neural response in the same way as needle acupuncture. Laser acupuncture is expected to work by suppressing the pain under neurological and humoral mechanisms, such as when using needles.

As an advantage when compared to laser therapy, laser acupuncture involves the irradiation of just few points related to the pathology, while the first requires the irradiation of multiple tender points at the sites of the pathology, and reduced treatment time (clinical chair-time). Compared to the traditional Chinese medicine (acupuncture), the stimulation of acupuncture points with the low power laser is not only painless but also has the advantage of being a noninvasive therapy, atraumatic and easy to be done by a qualified professional. Moreover, it also consists on a technique with reduced risk of infection, clinical chair-time and may be indicated for patients with fear of needles.

The objective evaluation of the effectiveness of laser acupuncture is difficult because treatment parameters such as wavelength, irradiance and beam profile are rarely fully described (de Oliveira et al., 2015b). The depth of action for the laser power, probably an important determinant of effectiveness, is governed not only by these parameters, but also by characteristics of patient's skin, such as age and pigmentation – factors that have also received little attention in laser acupuncture. Visual cortex activation was observed with the use of laser therapy in points of acupuncture localized at the feet (Siedentopf et al., 2002); however, further studies are required to show more evidence of the effects of laser irradiation on points of acupuncture.

For the treatment of paresthesia with low power lasers, the literature mentions three main objectives, which are: (1) to accelerate the regeneration of injured nerve tissue, (2) stimulate adjacent nervous tissue (or back side) - causing them to play the role of sectioned nerve - and (3) biomodulation of nervous response bringing the threshold potential action

into normality. Laser therapy applied to acupuncture points can provide the same benefits for the treatment of paresthesia that laser therapy provides, however associated with the effects of acupuncture.

It is important to consider which factors can be listed as relevant for a greater or more significant recovery of nerve sensitivity after orofacial surgeries or other interventions that can lead to nerve injuries. Recently, a retrospective study (de Oliveira et al., 2015c) analyzed 125 clinical records and evaluated the effectiveness of the laser therapy on the recovery of nerve sensitivity after minor oral surgeries and orthognathic surgeries. The following data were collected from patient's clinical records: gender, age, origin of the lesion, time interval between the surgery and the beginning of laser therapy, frequency of laser irradiation (once or twice a week), final outcome and if it was necessary to change the irradiation protocol during the treatment. These data were related to the recovery of sensitivity at the affected nerve region. Among all factors that could be related to the positive results of the laser therapy, authors reported that the patient's age and the time interval between surgery and the beginning of the laser therapy were the most important. The authors highlighted the importance of performing the laser therapy immediately after (or minimal time interval) the surgical intervention to obtain an effective sensory recovery. According to the study, the patient's age also influences the sensory recovery. Young patients are those with the more positive outcomes for nerve sensitivity recovery.

The evaluation of the frequency of laser therapy (number of sessions per week) have shown that patients submitted to laser therapy twice a week had an excellent recovery (8.43%) or reasonable recovery (34.94%) (de Oliveira et al., 2015c). Interestingly, in the same retrospective study, the patients treated once a week showed 16.67% of excellent recovery and 23.81% of reasonable recovery. This finding is important, since some *in vivo* studies (animal models) have shown the efficacy of laser therapy in neural regeneration when performing a daily laser treatment for up to weeks (Khullar et al, 1995; Matsumoto and Kimura, 2007; dos Reis et al, 2009). Future in vivo studies should be conducted to compare the frequency of laser therapy sessions, aiming to confirm the positive outcomes and benefits of laser therapy when conducted with a reduced number of clinical sessions.

Depending on the severity of the injury on the sensory nerve fibers, the time to obtain a significant clinical improvement in the return of the nerve sensitivity can vary considerably. When considering 1 or 2 sessions of laser therapy per week, de Oliveira et al. (de Oliveira et al., 2015c) reported that the time necessary to reach sensory recovery could range from 8 to 201 days.

Despite the great number of studies that reported the photochemical photophysical and photobiological effects of low power lasers (Karu, 2013), researchers agree that further studies should be performed with low power laser as a non-invasive treatment modality (laser therapy and laser acupuncture) for different diseases and injuries of peripheral nerves, aiming to establish standardized protocols that can be widely used in clinical practice. Double-blinded, randomized, controlled trials of these techniques (low level laser therapy and laser acupuncture) for the reestablishment of neural regeneration and for restoring normal sensitivity are necessary for understanding and acquiring a safe and effective protocol, where other professionals and researchers may be able to reproduce the use of these techniques as supporting therapies for treating paresthesia of different etiologies.

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