

Pain, Inflammation and Infection: A Daily Challenge in Every Clinical Practice; Role for Lasers?

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Dental pain management, by conventional means, involves the use of various drugs often in combination with surgical intervention. As clinicians we are often either suppressing pain via the inhibition of pain pathways by administering various classes of peripheral or centrally mediated analgesics. Alternatively, we may induce a temporary nerve block using topical or deeper acting local anaesthetics to permit surgical interventions of one form or another. Each of these strategies can be compromised by adverse factors including allergy, systemic toxicity or other untoward side effects, or poor patient compliance due to for example, needle phobia or compromised due to reduced or ineffective outcomes.

Normal measures can enjoy a high degree of clinical success, however, Dentistry as a profession has regrettably suffered from the negative association of pain and the consequent necessary interventions. Avoidance of clinical support is common within the community and deferred treatment is necessarily often more complex and associated with both increased costs to the patient as well as the need for more involved corrective therapies. The economic and social consequences are serious: in the UK for example the NHS spends £36,000,000 a year paying for hospital based general anaesthetic extractions in children [1]. A recent report from an insurer in the USA costed the requisite hospital based late management of common dental diseases leading to serious infections at 1.7 billion dollars over ten years in the State of Texas alone and infections also cost nearly 200 Texans their lives [2].

To better manage pain and the associated patient anxiety there have been many novel approaches to improve outcome with reduced complications and an increase in patient comfort. These include the use of minimally invasive treatment protocols such as air abrasion and disinfection of carious lesions using ozone. There are however limitations to what each of these methods can achieve and given the presence of pain associated with inflammation and infection it is then a normal necessity to adopt standard conventional approaches to care. Acute pain can however pose a challenge as in the presence of acute inflammation there can be an associated reduction in the efficacy of local anaesthetics. This can be due to local and centrally mediated factors: local anaesthetics are normally in an acidic solution to increase shelf life and stability prior to use. In the presence of inflammation tissues are typically in an anaerobic and acidic status due to poor perfusion related to oedema. Local anaesthetics require more basic alkaline tissues to be converted into an active form and injections into acidic tissues is both painful and can be less effective. If it is not possible to achieve a regional block or if there is extensive swelling associated with the affected area it is frequently necessary to defer intervention pending a reduction of the same following the administration of analgesics and antibiotics. Regrettably there are associated risks with deferred treatment which can include drug interactions, allergy or, on occasion, systemic infections which may result in sepsis. Other increasingly common problems can include a failure of the drugs to achieve adequate analgesia and bacterial resistance to many of the commonly prescribed antibiotics.

Given the facts of the problem there is the clear need for additional approaches to add to our armamentarium. In this respect, lasers have a lot to offer the discerning clinician. There is a common misapprehension that lasers are purely surgical devices and as such offer nothing more than an alternative approach to the standard equipment we use in daily clinical practice. It is certainly possible to argue that lasers offer some surgical benefits in the form of reduced trauma, improved haemostasis and improved clinical ease. However, in our view this totally misses the point as there are other aspects of laser integration that open a considerable number of highly useful clinical pathways including the management of pain, inflammation and infection [3,4].

To those not aware of the state of the evolving evidence base and the ever-increasing clinical experiences of laser users it may come as a surprise that laser energy can be a very useful tool to use as an adjunct to the management of pain, inflammation and infection. The simplest and most effective type of laser for photomedical sub surgical therapeutic use is the diode laser. This type of treatment is properly referred to as photobiomodulation (PBM) and given a little training, as it is a relatively short learning curve, the diode laser can become an indispensable daily aid to patient care in any clinical dental practice.

Following the product of over 50 years of research and the efforts of clinicians Worldwide we know a lot about the physiological and clinical outcomes associated with laser tissue interactions. Near infra-red (NIR) light has the capacity to penetrate deeply into biological tissues and given an appropriate tissue level dose it is possible to achieve some remarkable results. Take for example oedema: NIR stimulates the production and tissue release of nitric oxide (NO). This is a powerful vasodilator and in consequence the lymphatic drainage is improved and the lymphatics become less porous. Furthermore: NO also results in arterial and venous vasodilatation and the improved blood supply permits increased access to areas of infection or surgical induced trauma to a good supply of oxygenated blood. This leads to the rapid resolution of swelling plus a marked reduction in pain. In addition, local anaesthetics are better able to be converted into an active form and there is the specific uptake of pro inflammatory nocioinductive mediators such as IL-1b, IL-6 and TNF-alpha. Furthermore, the production of prostaglandin E2 is suppressed resulting in the progressive shift from pro inflammatory pathways towards resolution. The NIR is working locally on the same cellular targets as powerful drugs such as steroids and NSAID's however without any of the potentially toxic systemic effects [5].

These beneficial tissue effects are further boosted by the ability of NIR to change the redox status of the mitochondria so that they switch into a highly productive oxidative state of metabolism associated with a major step difference in ATP production. This favours an improved quality of wound resolution along with the more efficient and active mobilization of the immune system to combat infection as well as mitigate tissue damage. At a higher dose of NIR, enough localised heat can be generated to kill pathogens without causing significant collateral tissue damage.

In summary, a diode laser is an effective analgesic, a powerful anti-inflammatory and it can be used to improve the quality of tissue repair and regeneration. Furthermore, it can be used to kill pathogens and, of course, it can also be used for surgery. For these reasons, we view diode lasers as indispensable tools in daily clinical practice which deserves a place in every discerning dental surgery. Training is not too difficult and a single day long course is all that is necessary to learn how to safely and effectively use this remarkable device.

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