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Paediatric Lazer Dentistry

Sharipova G. I.

Independent candidate of the Department of Therapeutic Dentistry of the Bukhara State Medical Institute named after Abu Ali ibn Sina, Uzbekistan

ABSTRACT

Dental traumas are frequent and sometimes complex events, and at times real emergencies. There are no well coded guidelines for laser applications in these clinical events. Laser-assisted therapy can offer new treatment possibilities, simplify dental procedures, reduce postoperative sensitivity and the need for post-operative medications because of the laser-induced bio stimulating and anti-inflammatory effects.

KEYWORDS: Dental trauma; Laser dentistry; Low level laser therapy; Paediatric dentistry.

Introduction: Approximately 20% of children suffer a traumatic injury to their primary teeth and more than 15% injure their permanent ones. Maxillary central incisors (50%) and maxillary lateral incisors (30%) are the teeth most frequently affected, both in permanent and in primary dentition. The literature shows that boy sustain more traumatic dental injuries than girls. The revised classification of traumatic dental injuries of the World Health Organization includes injuries to teeth, supporting structures, and gingival and oral mucosa, and it is based on anatomical, therapeutic and prognostic considerations (Table 1) . Careful collection of dental history, a good clinical examination, diagnostic imaging, photographic documentation, pulp testing are required for a complete medicolegal report.

Laser in dental traumatology: hard tissues and pulp

Laser application offers multiple advantages in dental traumatology involving pulp and hard tissues.

- Pulp temperature increases only minimally during erbium laser treatment.
- Laser irradiation provides high decontamination of the exposed site (bactericidal effect).
- Laser ablation removes the smear layer and debris, leaving the dentinal tubules open and thus allowing the adhesion process.

The entire treatment can be performed with erbium laser, including preparation and conditioning for the reattachment of the fragment.

Laser therapy improves the psychological approach and the compliance of the patient, reducing discomfort and inducing laser analgesia by raising the pain threshold. Crown infractions are rare; non-ablative laser energy in a defocused mode reduces the enamel-dentin permeability, the bacterial load and thus sensitivity. The procedure can be repeated after 7 to 15 days. Enamel-crown fracture without pulp exposure (uncomplicated fracture) can be treated by using Erbium lasers. Erbium laser is used for enamel and dentin conditioning: signs of submorphological damage are related to the thermal vaporisation of the organic dentinal fibres and of the peripheral interprismatic enamel structure; acid etching is needed. A

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complicated crown fracture exposes the pulp: treatment depends on the size of the exposure and the timeframe between the traumatic injury and treatment. The options include: pulp capping (Fig. 1), partial pulpotomy, pulpectomy and root canal therapy. If the exposed area is very small (< 1 mm2) and the treatment is rapidly provided, pulp capping is the first choice of treatment: different laser wavelenghts can be used for decontamination and coagulation of the exposed pulp Pulp capping Among the clinical trials and histological investigations in animal models, Santucci was the first to report the high success rate (90% after 6 months) in vivo using Nd:YAG laser and a glass ionomer cement for pulp capping. Later studies reported different success rates (89-93%) after 1 and 2 years using a CO2 laser versus calcium hydroxide. Olivi et al. Have investigated in vivo different laser sistems and calcium hydroxide, reporting success rates of 80% for Er,Cr:YSGG, 75% for Er:YAG and 63% for calcium hydroxide alone. Recently, Cengiz and Yilmez have investigated Er,Cr:YSGG laser irradiation at low energy, with no agents and reported success rates after 6 months of 100% the laser, 73,3% for calcium hydroxide alone group and 66,6% for a resinbased tricalcium silicate material alone.

Yazdanfor et al have investigated a diode-laser-assisted method compared to conventional procedure, reporting 60% survival rate for the conventional method and 100% for the diode 808 nm procedure after one year. Several studies on different animal models have been performed by Jawardena et al. Using Er:YAG laser; Hasheminia et al. Reported better healing using Er:YAG laser with MTA in comparison with MTA alone. Suzuki et al have investigated superpulsed CO2 laser preirradiation on exposed rat pulp in three groups, one irradiated and directly capped with a self-etching adhesive system, one capped with the self-etching adhesive system and the third was capped with commercially available calcium hydroxide, and the self-etching adhesive system was applied to the cavity, reporting no significant differences between the groups. However, the CO2 laser irradiation showed a tendency to delay the formation of reparative dentin.

Laser pulpotomy and pulpectomy Pulpotomy is a very common technique in primary teeth, however several investigations using different wavelenghts reported controversial results. Pulpotomy can be performed by using CO2, Nd:YAG, Erbium and diode lasers. Two sistematic reviews presented different results. De Coster et al reviewed 7 articles and concluded that lasers (632/980 nm diode lasers, Nd:YAG, Er, YAG, CO2) were less successful than conventional pulpotomy techniques. Another study by Lin et al. [2012] including 37 studies and 22 meta-analyses highlighted that formocresol ferric sulfate and MTA had significantly better results in primary molar pulpotomy than calcium hydroxide and laser therapy in a 18-24 month follow-up study, with MTA as the first choice. More recent studies reported more positive results for lasers. Yadav et al reported a better outcome of diode pulpotomy and electrosurgical pulpotomy versus ferric sulfate pulpotomy after 9 months. A randomised clinical trial showed good clinical and radiographical results for laser pulpotomy performed on 30 primary molars. The importance of the sealing material was reported by different authors. There are few studies on laser use for pulpectomy (Indexed on PubMed) in primary teeth.

Laser in traumatic injuries to soft tissues: Traumatic injuries to supporting structures (alveolar bone, gingiva, ligaments, periodontium, fraenum and lips), defined as indirect traumas, can be effectively treated using lasers, especially the visible and near infrared types. These lasers are used for their ability to decontaminate the periodontal defect following a

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dental luxation or subluxation, for decontamination of the socket after an avulsion, for the ability to perform gingivectomy and/or gingivoplasty or surgical incisions (e.g. to remove a tooth fragment embedded in the soft tissue).

In all types of luxation injuries, lasers provide not only a bactericidal and detoxification effect (Er:YAG, Nd:YAG, and diode), but also favourable conditions for the attachment of the periodontal tissue, expecially in the permanent dentition. In dental avulsion, which is often associated with injuries to the lips, a diode or Nd:YAG laser can be used to decontaminate the socket, promote healing of the oral mucosa and reduce pain. Some studies underlined the importance of removing the infected granulation tissue from the soft tissue walls. The biostimulating and pain control effects obtained with Low Level Laser Therapy (LLLT) are an integral part of the post-operative treatment of these patients. If oral mucosa and gingiva injuries are present, the LLLT can be used to help the tissue repair process through cell proliferation activation and reduction of inflammation

There is a large body of literature on this particular topic, even though, methodologically and in terms of doses, there is still considerable difference of opinion.

Semi-conductor diode type lasers (803 to 980 nm) are near-infrared lasers that at low power can be used for effective treatment of pain and inflammation and to promote tissue repair with great tissue penetration. They can influence a large number of cell systems (fibroblasts, macrophages, lymphocytes, epithelial cells, endothelium) and can also have a series of benefits on the inflammatory mechanism, reducing the exudative phase and stimulating the reparative process

LLLT modifies nerve impulse stimulation and transmission and increases the metabolism of endorphins, acetylcholine, serotonin, and cortisol, resulting in reduced stimulation and perception of pain. LLLT increases production of adenosine triphosphate (ATP) as well as overall cell activity. Laser light increases mitochondrial ATP and can also react with beta growth factors. LLLT modifies blood flow and induces angiogenesis, and the modification of limph drainage reduces inflammation. The study of these new treatments might lead to the definition of guidelines and protocols with specific doses and application sites..

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