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Laser-Assisted tooth extraction: A review of clinical outcomes and application

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Abstract
Laser-assisted tooth extraction has gained attention in dental surgery for its advantages over traditional extraction methods. This review examines how lasers improve the extraction process by reducing tissue trauma, minimizing pain, and enhancing post-operative recovery. Using lasers in extractions promotes better bleeding control, lowers the risk of infection, and accelerates healing, making it a beneficial choice in select clinical cases. This article also discusses the types of lasers commonly used, their clinical effectiveness, limitations, and potential future developments. Understanding the role of laser-assisted extraction can help dental professionals improve patient care and outcomes.

Keywords: Laser-assisted tooth extraction, dental lasers, minimally invasive dentistry, hemostasis, dental surgery, infection control, tissue trauma reduction

Introduction

Tooth extraction is a common dental procedure where a tooth is removed from its socket in the bone. Traditionally, this was done with manual tools like forceps, which could cause tissue damage, bleeding, and longer recovery times. Many patients also experience discomfort, require local anesthesia, and may face complications like infection, pain, and swelling.

Recently, laser technology has changed dental practices by offering a less invasive alternative. Lasers are now used in various procedures, including soft tissue surgeries and cavity preparation. Laser-assisted tooth extraction has become more popular because it provides greater precision, reduces damage to surrounding tissues, and minimizes discomfort. Additionally, lasers help control bleeding and lower the risk of infection, leading to faster healing and fewer complications.

Types of lasers used in tooth extraction

Erbium YAG Laser

Erbium lasers are effective for removing enamel, dentin, cementum, and bone, making them useful for procedures like root tip extractions. When combined with water irrigation, the laser removes tissue while minimizing damage. The water helps clear debris, and the laser also sterilizes the area. However, since the laser doesn't target only hard tissue, care must be taken to avoid damaging surrounding areas [1].

Diode Lasers

Diode lasers and electrosurgery are alternatives for exposing impacted teeth, especially if they're not deeply buried in bone. Diode lasers help sterilize and speed up healing, while electrosurgery controls bleeding but can cause more damage. Compared to scalpels, lasers need less anesthesia, cause less pain, and result in fewer complications like bleeding or swelling. The laser cuts and reshapes tissues with minimal bleeding, often without needing stitches, and helps tissues heal without lasting damage [2].

Among various laser systems, diode lasers are commonly used for Low-Level Laser Therapy (LLLT) to enhance wound healing in both animal and human studies, as their wavelength penetrates deeply into tissues [3].

CO2 Lasers

One of the earliest lasers used in soft tissue surgery was the CO2 laser. Emitting light with wavelengths of 10,600 nm and 9300 nm, it can function in either continuous or intermittent modes. By sealing nerve endings, the CO2 laser's high temperature helps limit bleeding, remove tissue rapidly, maintain sterility, and lessen pain and inflammation following surgery. The CO2 laser effectively vaporizes oral tissues because they contain a high percentage of water (70–90%). Through photothermal effects, the laser promotes cellular rupture, which results in tissue vaporization [4].

Nd: YAG Lasers

The Nd: YAG's deeper penetration results in the thickest coagulation layer and hemostasis. The laser radiation can biostimulate the surrounding tissue to create angiogenesis and fibroblasia due to its deeper penetration. Osteonecrosis after tooth extraction in patients on bisphosphonates has been effectively treated with biostimulation using the Nd: YAG [5].

Mechanism of Laser assisted extraction

Dental lasers use a fiberoptic cable, hollow waveguide, or articulated arm to transmit light to the target tissue. Other parts include cooling systems and focusing lenses. The active medium, which might be a gas, crystal, or semiconductor, determines the laser's wavelength and other characteristics [6].

Four possible interactions between the laser light and tissue are absorption, transmission, scattering, and reflection. Depending on the amount of water in the tissue, the laser causes photochemical reactions by raising its temperature when it is absorbed. The tissue vaporizes (dissolves) at 100°C. Proteins denature at 60°C to 100°C without causing

tissue vaporization. Above 200°C, the tissue burns and dehydrates, which results in carbonization—an undesirable outcome [7].

Clinical benefits of laser assisted tooth extraction

There are a number of benefits to laser-assisted tooth extraction over conventional techniques. The accuracy of the laser speeds up healing and lessens bleeding and postoperative pain. The laser reduces the chance of infection and minimizes tissue damage by sterilizing and cauterizing as it cuts. This method promotes a less invasive, more patient-friendly operation, which is in line with the general trend in dentistry toward faster recovery times and better results overall

A substitute for cutting and rotating instruments in surgical dentistry is high-intensity laser radiation. Diode lasers for surgical procedures provide the following advantages: high incision precision, anticipated depth of injury, and sterile conditions during the procedure and prevention of bleeding during and after surgery. Using a diode laser has demonstrated a good hemostatic effect over time, resulting in minimal gingival margin degradation [8].

The erbium laser promotes hemostasis and lessens postoperative discomfort and swelling by cutting and coagulating tissue at the same time. Because of its bactericidal action, it reduces scarring, promotes tissue regeneration, and increases oxygen levels, all of which speed up healing. This approach allows for efficient treatment in outpatient settings without requiring a lot of preparation, which is particularly useful for dental surgery in patients with primary immune thrombocytopenia [9].

Excellent hemostasis is achieved by CO2 lasers because they make reasonably deep and precise incisions [10].

Clinical studies and outcomes

Borzabadi-Farahani, A evaluated the efficacy of diode laser-assisted tooth extractions for impacted teeth in comparison to conventional surgical techniques. According to key findings, diode lasers offer a less intrusive and cleaner alternative, lowering or eliminating the need for sutures and minimizing discomfort and bleeding following surgery. It has been demonstrated that diode lasers, which have wavelengths between 808 and 980 nm, improve perception and healing time. However, the study's shortcomings include insufficient follow-up, uneven methodology, and small sample sizes. More thorough testing is advised to determine safety, optimal laser settings, and best practices [2].

Immediate laser-induced hemostasis in anticoagulated rats subjected to oral soft tissue surgery:

De Oliveira Campos, *et al.* conducted a study showing, anticoagulated patients undergoing soft tissue surgery may benefit from the use of high-power lasers to control bleeding. During lingual frenectomy in anticoagulated rats whose greater bleeding was caused by a higher INR from warfarin, diode lasers immediately stopped the bleeding in our double-blind trial.

Rats were housed in separate cages for 72 hours in order to regulate their intake of warfarin; however, visual, auditory, and olfactory contact helped to reduce isolation stress.

Bleeding can be a serious issue in dental settings, especially for general practitioners. Patients taking anticoagulants are more likely to have untreated dental problems and receive less dental care since both patients and dentists are frequently concerned about bleeding concerns [11].

Limitations

- Additional education and training are needed for different clinical uses and laser varieties.
- It is expensive to adopt technology, buy equipment, and fund necessary education.
- Since different wavelengths are needed for different processes, multiple lasers can be necessary [12].

Conclusion

In conclusion, there are a lot of advantages to laser-assisted tooth extraction, particularly for patients who are at risk of bleeding or who are taking anticoagulants. By reducing pain and swelling, controlling bleeding, and promoting healing, lasers help make the surgery less intrusive and painful.

Further study is necessary to verify the long-term safety and efficacy of laser use, as it necessitates specific training and equipment. With more research, lasers may prove to be a useful instrument in dental surgery, enhancing patient care and results, especially for patients who are more susceptible to difficulties.

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