Review Article

Laser-assisted dental procedures: Is it a safe tool to be considered in pregnant patients? A Brief review.

Abstract:

Introduction: Laser technology has recently gained more attention among dentists due to its advantages, such as controlled bleeding as well as reduced pain and inflammation. However, the literature contains insufficient data concerning its safety for use in pregnant patients. The aim of this brief review is to describe what the literature provides us concerning laser treatment for emergency or elective procedures in gravid patients.
Materials And methods: We conducted an electronic search in Medline and Web of Science using the search string ¨dentistry¨ AND ¨laser treatment¨ AND ¨pregnancy¨.
Results: We found 4 case reports of laser surgical treatment of pyogenic granuloma in pregnant patients showing no fetal complications.
Conclusion: The few reports found in the literature did not show any pregnancy -related or fetal complications stemming from the use of the laser treatment to manage oral pathology during pregnancy. Nevertheless, more investigation and well-designed clinical trials are necessary to determine the safety of the use of various laser wavelengths for emergency or elective dental treatments during pregnancy.

Keywords: Laser treatment, Dentistry, Pregnancy, Pyogenic granuloma.

Introduction:

Laser technology was introduced in dentistry in the 1960s. The ruby laser (wavelength 694.3 nm) was first used mainly for photobiomodulation purposes (1). Other laser wavelengths were introduced later, such as Nd:YAG (1064 nm) and CO_2 (10600 nm) lasers for applications using high-power output for soft-tissue surgery and later for superficial dentine melting to seal the dentinal tubules in root canal treatments (2).

Today, laser systems have several benefits when implemented in dentistry such as tissue ablation with minimal thermal damage compared to electrocautery, post operative pain reduction (3), and bactericidal effects (4). Antimicrobial photodynamic therapy is another alternative with the advantage of using low-power settings that decreases the risk of thermal damage (5). These features have increased dentists´ interest in laser applications.

There is a knowledge gap concerning the safety of laser applications in pregnant patients due to the limited evidence available in the literature because clinical trials have not focused on them and in most of the studies, pregnancy is considered an exclusion criterion. Nevertheless, few reports have described the safety of various lasers for the treatment of other medical conditions during pregnancy, such as urolithiasis, skin diseases, genital wart removal, and varicose veins in the lower extremities, without fetal complications (6, 7).

During pregnancy, the oral microbiota and salivary PH can change due to hormonal imbalance, which enhances bacterial growth and increases the risk of infection, which can easily spread due to the increased blood volume and circulation. Also, the cell-mediated immune response could change and increase infections´ severity (8). Furthermore, fetal health is closely associated with the oral cavity´s condition; for example, authors have reported the association between periodontal disease and preterm labor or low birth weight (9). Nevertheless, pregnant patients are still resistant to seeking dental care due to a lack of awareness about it among the population; therefore, dentists should insist on awareness of the recent guidelines for oral health care during pregnancy (10).

The aim of our review is to describe what the literature provides us concerning laser dental treatments and their safety for pregnant patients during emergency and elective procedures.

Materials and methods

We conducted a digital search in Pubmed using the search string ¨((dentistry) AND ((lasers) OR (laser therapy) AND (pregnancy))¨. We conducted another search in Web of Science and Embase using the search string ¨ALL=(dentistry) AND ALL=(lasers) AND ALL=(pregnancy)¨. We also conducted a manual electronic search to retrieve other studies related to the topic using Google Scholar.

Results

Four articles were found (11- 14) related to the use of lasers in dental treatment in pregnant patients and all of them were related to laser-assisted surgical treatment of pyogenic granuloma during pregnancy (Table 1).

Discussion

There are general guidelines of dental care to be followed according to the pregnancy phase (15). In the first trimester, the patient should be educated about the physiological oral changes that can occur during this period and the importance of following strict oral hygiene and plaque control measures. During this phase, fetal organogenesis occurs and the risk of spontaneous abortion is 12 %; therefore, the dental treatments should be limited to prophylaxis and emergency care and omit radiographs when possible.

During the second trimester, elective and emergency care can be safely performed, active oral diseases should be controlled, and radiographs should be used selectively following standard protective measures, such as a lead apron and thyroid collar.

The third trimester involves an increased risk of preterm labor (16). Moreover, the patient is more prone to experiencing discomfort; therefore, the chair time should be shortened, avoiding the supine position to prevent supine hypotensive syndrome and gastrointestinal reflux. Postponing the elective procedures to the postpartum period is recommended.

Pharmacological treatments should be prescribed with caution due to the reported fetal teratogenic effects of some drugs, such as antibiotics, analgesics, and antifungals (15,17), which make non-pharmacological alternatives very interesting for further investigations. Lasers can be considered a non - pharmacological adjunctive treatment in several dental procedures (18,19).

Each wavelength is absorbed differently in each of the tissues and produces different biological effects. For example, diode lasers have a greater tissue penetration ability than the erbium-family lasers. The correct use and sufficient education in this field are necessary for safe laser applications and treatment protocols.

Light emitting diodes (LEDs) are an alternative to lasers for use in photobiomodulation and photodynamic therapy. They are considered safer because they are less hazardous to the eyes and are less likely to produce thermal tissue damage than class IV lasers which are by definition the lasers that can cause skin damage or permanent eye damage as a result of direct, diffuse or indirect beam viewing.

Pregnancy and periodontal conditions

Increased hormone levels during pregnancy can cause periodontal alterations such as bleeding upon probing; tooth mobility; and increased virulent

periodontal bacteria, such as *porphyromonas gingivalis* and *prevotella intermedia* (20).

Some types of lasers, such as diode lasers, have several therapeutic benefits, such as anti-inflammatory effects and enhancement of the local immune response (21). Teymouri et al (22) found a significant reduction in interleukin (IL) -1B and IL-17 levels with laser treatment in patients with chronic periodontitis as well as a significant decrease in bleeding upon probing over time in laser-treated groups compared to the conventional scaling and root planning.

Another condition, pregnancy tumor or pyogenic granuloma, occurs in 5% of pregnancies due to an increase in the progesterone level in the presence of local irritants and lack of plaque control. It is usually reversible and resolves spontaneously after delivery in most cases (23). However, its excision is indicated when it interferes with occlusion or when it manifests pain or bleeding; otherwise, recurrence is common during pregnancy.

We found 4 reports of laser excision during pregnancy (11-14). Two authors reported the use of a Nd:YAG laser (11,13), one reported the use of CO2 laser (13) and one combined a diode laser with CO2 lasers (14). Regarding the intraoperative intervention, the authors reported several common benefits, including reduced operating time, less bleeding, eliminating the need for suturing, faster recovery with less postoperative pain, less inflammation, and accelerated wound healing. Another advantage is the ability to perform the surgery without local anesthesia as reported by Zeng et al, (11) who used a Nd:YAG laser at 1W without contact prior to the surgical excision. None of the authors reported lesion recurrence or pregnancy-or labor-related complications after the laser-assisted procedures.

Dental caries during pregnancy

Caries risk can increase during pregnancy due to the increased salivary acidity, stemming from repeated vomiting or morning sickness during the first trimester as well as a possible increase in acid reflux due to the laxed esophageal sphincter. Furthermore, the nausea some patients experience can lead to avoidance of tooth brushing and a decrease in its frequency as well as dietary factors, such as increased sugary-food intake and altered meal frequency. Early detection and treatment of carious lesions is preferable during the second trimester to avoid complications.

Local-anesthetic (LA) administration is commonly necessary to complete most of the restorative procedures. Although LAs are considered safe for administration during pregnancy, being classified as category B or C, depending on the type of anesthetic agent, care should be taken to avoid administration of high doses or accidental intravenous injections. Lidocaine is the most commonly used LA, and high doses during pregnancy can cause fetal bradycardia and inhibit myometrial contractions (24,25).

Erbium-family lasers are a suitable option to consider in these procedures because they can efficiently ablate hard tissue, such as enamel and dentine, with few surface alterations (26). The laser cavity preparation is more comfortable, generates less vibration, and requires less local anesthetic than conventional rotary techniques, and it has a very high acceptance rate among patients (27). Furthermore, Erbium Chromium: Yttrium Scandium Gallium Garnet (Er,Cr:YSGG) lasers generate fewer aerosols during cavity preparation than conventional rotary instruments, thereby reducing the risk of airborne-diseases transmission (28).

There is a lack of reports in the literature of pregnant patients treated with erbium-family lasers; however, we found no reported complications~~, either~~. The erbium lasers are highly absorbed by water, and the ablative effect is local, with very limited depth of penetration, and theoretically, it should have no adverse effects on the fetus.

Endodontic procedures during pregnancy:

Hormonal changes in gravid patients, such as in periodontal tissues, can also aggravate the intensity of the pulpal-tissue inflammation. Irreversible pulpitis and acute apical periodontitis are the most common clinical presentations of emergency endodontic cases. Regardless of the pregnancy trimester, the painful episode should be treated to eliminate the cause (29). Moreover, apical periodontitis can lead to an increased risk of preeclampsia (30).

Endodontic treatment can safely be provided during pregnancy if adequately planned for, preferably in the second trimester. It is important to consider the use of electronic apex locators to minimize the need for radiographs and rotary instruments (to minimize the chair time) and adequate patient position (semi-supine to avoid vena cava syndrome). Intraoral radiographs should be used only when necessary, and in such cases, a lead apron and collar protection are necessary, and the use of more sensitive high speed digital devices, which administer less irradiation time, is preferable (31).

Intracanal laser disinfection can significantly reduce bacterial count compared to conventional chemo-mechanical disinfection (32-34). The use of an Er,Cr:YSGG laser with a low concentration of sodium hypochlorite (NaOCl) (0.5%) provides results comparable to those from the use of the recommended higher concentrations (5.25%) during conventional endodontic procedures. This lower concentration can reduce the risk of the severity of hypochlorite accident if it is extruded through the apex (35).

Post-operative pain control is crucial after endodontic treatment. Paracetamol is the drug of choice to manage odontogenic pain during pregnancy because early exposure to NSAIDS can lead to birth defects and low birth weight. Nevertheless, the prevalence of NSAID intake during pregnancy is reported as 34% for pain control (36). Some studies (37,38) have shown a significant decrease in analgesic intake in the postoperative period when intracanal Nd:YAG or diode laser disinfection is used during endodontic treatment. It can

be considered an added value to be used in pregnant patients to reduce the likelihood of experiencing post-operative pain.

Photobiomodulation:

Photobiomodulation is another aspect of laser therapy that has applications for several pathologies due to its anti-inflammatory and analgesic effect and its acceleration of wound healing. The photobiomodulation treatment depends on the intrinsic cellular chromophore that absorbs the laser light to reach the therapeutic goal by stimulating the mitochondrial activity. Near-infrared wavelengths are commonly used due to their deeper tissue penetration (39).

There is no evidence of this tool's safety in dentistry when it is used in pregnant patients. Nevertheless, during dental treatments, no direct abdominal laser irradiation is performed, and the near-infrared lasers will lose more than 50% of their energy at a depth of 4mm. (40) In the case of using very high powers, superficial direct tissue damage will occur before the energy reaches the fetus due to the presence of superficial chromophores. No adverse effects have been reported, even when infrared lasers are applied near the fetus, as Traverzim et al (41) showed in a randomized controlled clinical trial with pregnant patients to assess the analgesic effect in the lumbar region during labor when they are previously irradiated with LED over the dorsal area between T10 and S4 compared to a hot shower. The authors did not report any birth complications for the mother or the baby, and they found a statistically significant subjective pain reduction in the LED group during labor.

In the absence of known adverse effects or contraindications during pregnancy, photobiomodulation might be considered an effective adjunctive therapy after endodontic treatments or tooth extractions. Also, it can alleviate the symptoms and accelerate the healing of recurrent aphthous ulcers or herpes simplex (42,43).

Today, we have no specific guidelines concerning whether high- or low-power laser devices are more suitable during pregnancy. Wilkerson et al (44) searched the academic database LexisNexis to identify legal cases of laser therapy and pregnancy. They found 76 legal cases, but none of them proved that laser treatment caused fetal harm or affected the pregnancy course.

Conclusion:

There is a lack of evidence in the literature concerning the recommendations for the use of laser treatments during pregnancy. However, pyogenic granuloma is the only condition reported in dentistry related to laser treatment and pregnancy, and it did not lead to any maternal or fetal complications.

Laser applications can be implemented when indicated if the dentist has adequate knowledge and heeds safety precautions. The use of lasers could be a great advance in this group of patients avoiding complications associated with usual procedures, minimizing chair time and patient discomfort.

Finally, more clinical trials including pregnant patients are required to show the efficacy and safety of the use of lasers in various procedures.

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Table 1. Data extraction of the 4 case reports related to the laser treatment of the pyogenic granuloma in pregnant patients.

Author	**Venkatasubramanyam A. et al (2018)**	**Ong MA. Et al (1998)**	**Zeng H. et al (2019)**	**John L. et al. (1994)**
Lesion location	Lower anterior vestibular gingiva	Lower anterior region	Upper anterior gingiva	Right lower posterior gingival area
Lesion size	1.2 x 1.5 cm	6 x 5 x 3 cm	17 x 6 x 11 mm (labially) and 21 x 8 x 14 mm (Palatally)	3.5 x 2.5 x 2 cm
Patient´s age (years)	22	28	26	19
Weeks of gestation	32	32	34	37
Reason for surgical removal	Not reported	Recured lesion and Interference with speech and mastication	Massive bleeding during brushing and eating	Painful on teeth brushing and eating
Laser used	Diode laser (980 nm) and CO2 laser (1006 nm)	CO2 for incisional biopsy to confirm diagnosis and the complete excision was planned after delivery	Nd:YAG pulsed laser	Nd:YAG
Anesthesia	Local anesthesia	Biopsy under local	Laser analgesia	General anesthesia

		anesthesia	at 1W	
Parameters	Diode laser: 2.5W continuous wave in contact mode for lesion excision. CO2 laser: 2.5-4W continuous wave in non-contact mode for gingivoplastia.	Not reported	400 microns fiber at 1 W for anesthesia -like effect then 3W water cooled in contact mode in movement 15 seconds each pass.	Pulsed 14W with pulse duration of 1.6-48.2 sec and pulse energy of 22-675 joules using 1000 microns tip, then hemostasia at 15W in non-contact mode
Recurrence	No recurrence at 18 months follow-up	No recurrence reported after complete excision and extraction of the teeth related to the lesion at 18 months follow-up	No recurrence reported	No recurrence reported.
Pregnancy related complications	No reported complications	Not reported	Patient gave birth to a healthy baby at 40 weeks gestation	No post-operative complications and the patient required cesarean labor at 40 weeks due to breech presentation.