

ADJUNCTIVE INFRARED DIODE LASER THERAPY ACCELERATES HEALING IN APICAL GRANULOMAS: A CASE REPORT STUDY

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The final stage of severe infection round the apex of a tooth is granuloma formation, the treatment of which can be a major problem in clinical dentistry. Although granulomas in the early stages can respond to conservative conventional therapy, such as the application of calcium hydroxide, many in the later stage require surgical intervention with the risk of postoperative sequelae and patient downtime. Low reactive-level laser therapy (LLLT) has been shown to reduce inflammation and accelerate wound healing. The present study was designed to assess the role of 830 nm diode laser therapy in conjunction with conservative conventional therapy in the treatment of severe apical granulomas. Thirty-three young male patients with severe apical granulomas participated in the study, 19 of whom were treated with conventional treatments, and 14 with calcium hydroxide combined with 0.5 J/cm²–2 J/cm² intra- and extraoral diode laser therapy. Significant improvements were seen in the LLLT combination group compared with the control group in the time taken for the resolution of acute postoperative pain (100 vs 500 min) and inflammation (1.6 vs 5.6 days), and long-term tooth remineralization and alveolar bone regeneration (15 vs 33 months). LLLT with the 830 nm diode laser was shown to be safe and effective in combination with conservative conventional therapy in the treatment of severe apical granulomas and was superior to the conventional approach on its own for granulomas of similar severity.

Key words: 830 nm laser therapy, apical granuloma, bone regeneration, calcium hydroxide.

Introduction

In clinical dentistry, the granuloma is a mass of granulation tissue which develops at the tip of a tooth root, the tooth apex, and is usually the final stage of a severe infection within the tooth pulp which contains blood vessels, nerves and connective tissue. Granuloma formation is associated with discomfort and pain, gradual demineralization of the affected tooth, and as the lesion grows in severity, with resorption of the alveolar bone and excessive mobilization of the tooth, leading to difficulties in chewing.

Treatment of granulomas depends on the severity. In the early stages of the pulp infection, before granuloma formation, the purulent infection can be drained out of the tooth cavity using an application of calcium hydroxide, followed by removal of all the pulp and filling of the root canal. The tooth can usually be preserved at this stage. In severe granuloma formation,

the usual conventional approach is surgical, involving extraction of the tooth, or apical resection with the aim of trying to keep most of the tooth in place. Both of these approaches imply a mutilating procedure for both tooth and soft and hard alveolar tissue as well as the possibility of postoperative sequelae, such as inflammation, hematoma, bleeding, infection and pain, with a downtime for the patient of from 1 to 3 days or more in really severe cases, as well as the prescribing of expensive medication, coupled with the possibility of postoperative failure and recurrence, and maxillary sinus complications.

Low reactive-level laser therapy (LLLT) has been shown to be effective in reducing inflammation and accelerating wound healing in hard and soft tissues (1-7). The present study was designed to ascertain the efficacy of LLLT in combination with conservative conventional therapy, calcium hydroxide application, compared with conventional treatment on its own.

Subjects and Methods

The LLLT system used was an infrared diode laser (BTL 10 Company Ltd., Czech Republic) at a wavelength of

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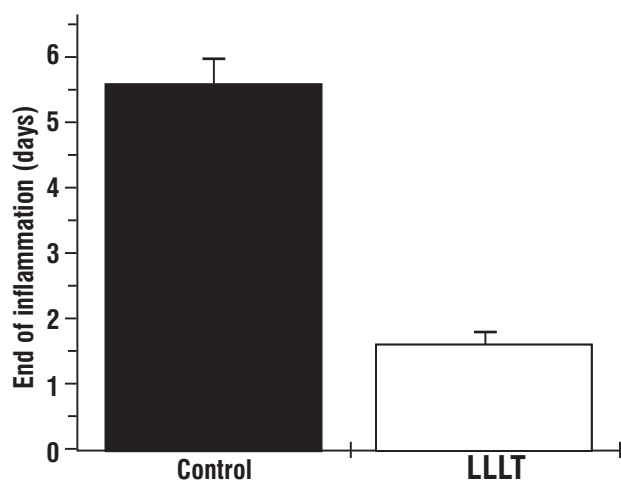


Fig 1: The time in days for the complete resolution of inflammation compared between the classical therapy group, and the group treated with conventional therapy plus LLLT.

830 nm, 50 mW output power. Both the intra- and extraoral irradiation was carried out in the Nogier frequency, with an incident energy density per irradiation time from 0.5 J/cm² up to 2 J/cm². The laser parameters were automatically adjusted according to the depth of penetration required, from 2.5–12 mm.

Subjects

The effects of conservative classic treatment plus LLLT effects were compared with classical treatment by monitoring a group of 33 young male patients (age 25–39) with the same diagnosis, similar medical history and similar degree of granuloma. Nineteen of the 33 were treated with the classical approach on its own, while 14 underwent conservative classical treatment complemented with LLLT.

Conventional treatment

The classical approach to granuloma consisted of extraction, other surgery, or, in mild cases, calcium hydroxide, each on its own.

Method

LLLT consisted of two parts: direct intraoral irradiation of the affected tooth with an optical fibre fed down into the root via the tooth canal to irradiate the granulomatous region from within; and extraoral irradiation of the maxillary skin over the affected area, placing the optical fibre over the granulomatous area (1). The LLLT continued for six weeks, if necessary: in the first week, one session each 2 days, two sessions in the second week, and then one session each week. The average number of required sessions was six. Together with the LLLT at the above parameters, we used calcium hydroxide endo-

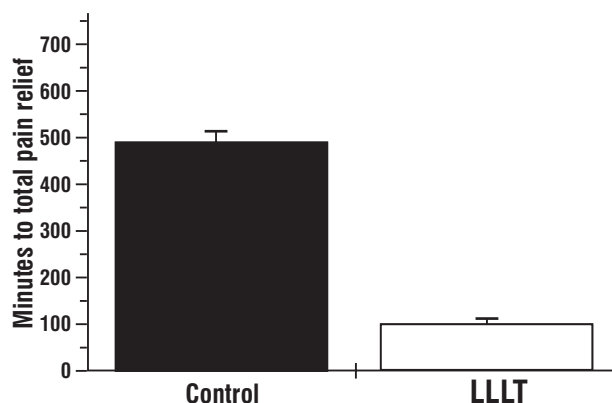


Fig 2: The time in minutes necessary for complete pain relief as measured by the patients' journals, comparing the control group and the group treated with conventional treatment plus LLLT.

dontic therapy, which consists of filling the tooth canal with calcium hydroxide that drains out the purulent infection from the pulp. The results obtained with classical treatment on its own versus classical treatment accompanied with LLLT were compared.

Results

In all 33 patients, the side effects of acute inflammation and pain immediately post-treatment were assessed from diaries kept by the patients, and compared between the control and the conventional plus laser therapy groups, in addition to long term bone recovery assessed from X-ray images.

Acute Inflammation

Figure 1 represents the average evolution of acute inflammation (in days) comparing the control group with the LLLT combination group. The LLLT group demonstrated a significantly faster recovery than the control group: 6.6 ± 0.8 for the control group, and only 1.6 ± 0.25 days (i.e. 24.2%), for the LLLT treated group, an approximately four-fold improvement ($P < 0.01$, paired t-test).

Pain relief

Recovery from postoperative pain took 500 ± 20 minutes in the control group, but only 100 ± 7.2 minutes in the laser therapy group, a five-fold improvement in favor of the latter. ($P < 0.001$, Figure 2)

Bone regeneration

Alveolar bone regeneration and the mineralization of the treated teeth were assessed from X-ray images. An average of 33 ± 5 months was required in the control group, but just under half of that time in the laser therapy group, 15 ± 2 months ($P < 0.05$, Figure 3).

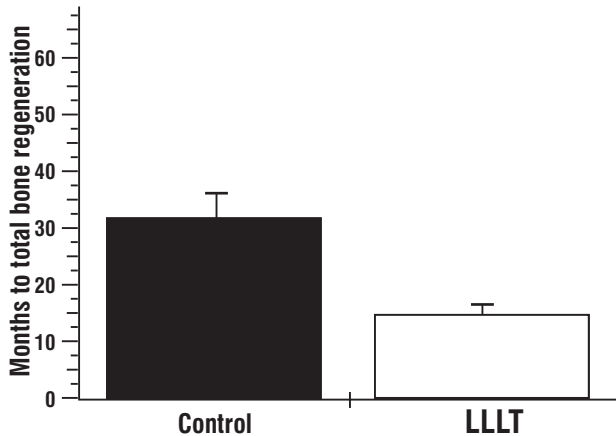


Fig 3: The time in months required for bone regeneration compared between the control and LLLT treated groups, evaluated from X-ray images.

Over the trial, it was noted that the individual results depend on the general health status, degree of patient compliance with post-treatment care instructions and the metabolic activity of each patient.

Case reports

Three cases will be reported, one treated with conservative classical treatment plus LLLT, and the other two treated with classical approaches on their own.

Case 1. A 36-year-old male presented with paradontosis and apical granuloma. He was treated with conservative classical treatment in combination with 830 nm diode LLLT. Figure 4a gives the pretreatment X-ray findings, showing severe cystic apical granuloma in a maxillary canine tooth. The patient found chewing difficult, as the tooth was fairly mobile. After 8 weeks of combined conservative classical treatment in combination with laser therapy, Figure 4b gives the posttreatment findings. The X-ray showed that bone mineralization was visibly restored, purulent secretion at the tooth apex had disappeared, halisteresis (bone vacuolization) had disappeared, the bony structure in the area was more radiopaque and the tooth function for chewing was restored.

Case 2: A 34-year-old male, with a cystic granuloma, was treated with conventional calcium hydroxide treatment on its own. Figure 5a shows the pretreatment findings. After eight weeks of calcium hydroxide therapy (Figure 5b), the X-ray findings of the granuloma region shows that the inflammatory process was still present and there was no evidence of mineralization. At that point, the tooth was still in the sub-acute stage of infection.

Case 3: A 36-year-old male presented with a maxillary cystic granuloma. The patient refused laser therapy, and



Fig 4: X-ray findings in Case 1. **a:** X-ray image of a cystic apical granuloma in a maxillary canine tooth before treatment. **b:** X-ray image of the same maxillary canine tooth after eight weeks of LLLT associated with hydroxide calcium therapy.

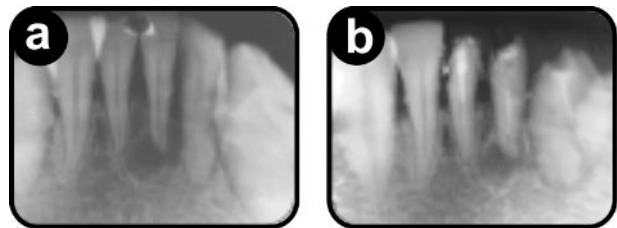


Fig 5: X-ray findings in Case 2. **a:** X-ray image of an cystic apical granuloma round a mandibular tooth, before treatment. **b:** X-ray image of the same mandible tooth after eight weeks of treatment with calcium hydroxide without LLLT. There is still inflammation in the apical area with no mineralization of the tooth apparent.

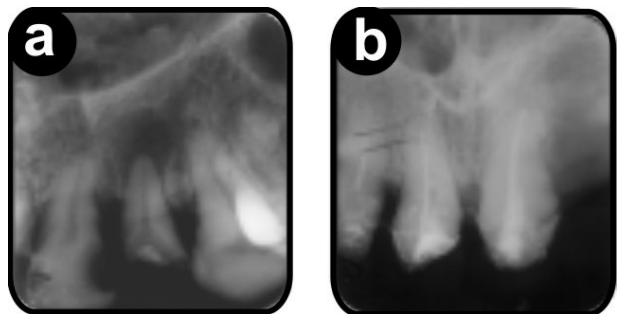


Fig 6: X-ray findings in Case 3. **a:** The pretreatment X-ray image shows a maxillary cystic granuloma complicated with sinusitis of endodontical origin. **b:** X-ray image showing the infected area after the extraction of the granulomatous tooth.

an extraction was planned. Figure 3a gives the pretreatment findings. Examination of the X-ray images before (Fig. 6a), and after the treatment (Fig. 6b) showed that the regional problems and the sinus infection were still present. The patient was sent to the otorhinolaryngology, head and neck surgery department of his local

hospital for treatment of the sinus infection. The result of the tooth extraction was a mutilation leading to a morphological and functional dysfunction and resorption, which will most probably require complex and expensive prosthetic treatment.

As with Case 3, patients treated with conventional treatment are prone to suffer from postoperative sequelae such as inflammation, hemorrhage, infection and pain, requiring other treatment strategies and loading more cost onto the patients for antibiotics and vitamins. In addition, patients suffering from these side effects require down-time from their work and social life of 1 to 3 days or more.

These three cases were representative of the 33 monitored patients in whom 19 underwent classical treatment and 14 had the conservative conventional treatment together with 830 nm LLLT.

Discussion

Low level laser therapy (LLLT) is a purely light-mediated process which requires no medication, is easy to apply, is pain free, and is well-tolerated by patients of all ages. The application has not been associated with any adverse side effects. Despite its popularity in other specialities,(1-8) laser therapy has taken longer to be accepted in dentistry.(8-11) This may be as a result of the sometimes confusing reviews and critiques of LLLT,(12,13), although a recent meta-analysis of the literature has shown very positive effects of LLLT.(14) The clinical efficacy of LLLT is further backed up by studies at a basic level.(15-18)

The present study shows clearly that laser therapy as an adjunct to a conservative conventional treatment, namely the filling of the tooth canal with calcium hydroxide to drain the infected pulp, was very successful in treating serious apical granulomas of the maxillary jaw, which may also be associated with sinus problems.

The subjects of the control and LLLT combination groups were matched as much as possible as far as severity of granuloma and clinical history, yet in the assessment of pain relief, inflammation and alveolar bone regeneration the LLLT group was significantly superior to the control group.

The classical approach to treat severe granuloma involves extraction, or an apical resection in which the most badly damaged part of the root is surgically removed, leaving the tooth in place. The latter can only be indicated when the tooth has no mobility problems due to erosion of the socket in the alveolar bone cause by the granuloma. In both cases, the sequelae can be severe, leading to the patient being socially dysfunctional and having to take from 1 – 3 days off work, or even more in really severe cases.

Laser therapy, on the other hand, when associated with the conservative classical approach to mild granu-

loma of calcium hydroxide application, gives a clearly superior treatment of granulomas, and even in severe ones. This combined approach offers an excellent healing effect with a shorter overall treatment time, minimal trauma to teeth and gums, and avoids the added expense of antibiotic and vitamin treatment often required to treat the remaining infection and inflammation after a surgical approach.

LLLT has been shown previously to increase bone mineralization compared with unirradiated controls in the rabbit mandibular injury model,(19) at a genetic level to up-regulate osteoblast activity(20-22) and to enhance the osseointegration between host bone and a hydroxyapatite implant.(23) Its efficacy in wound healing, particularly of compromised areas including granulomas, is well-documented.(8,11)

The present study had a comparatively small population, all subjects being of the same sex and of similar ages, and with matched medical histories. Studies with larger both-gender populations, other age groups and medical history groups are necessary in order to evaluate the general impact of LLLT in granuloma treatment, and other periodontal conditions.

Conclusions

Compared with conventional approaches on their own, the use of LLLT in conjunction with calcium hydroxide treatment was associated with quicker recovery from acute pain and inflammation, complete and rapid healing, preservation of the tooth, with a more rapid alveolar bone regeneration and elimination of any local inflammatory problems, meaning less cost and less trauma for the patient.

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