



Laser Assisted Surgical and Orthodontic Treatment of a Dilacerated Impacted Maxillary Incisor: A Case Report

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ABSTRACT

Impaction of the anterior teeth, which is less frequent in central incisors, can cause serious esthetic and subsequent psychological problems for patients during the mixed dentition period. Traumatic injury to deciduous teeth is the most common etiologic factor. Thus, treatment of maxillary incisor impaction is highly important. Nowadays, application of laser has been suggested in orthodontics and pediatric dentistry for different treatments, such as surgical exposure of impacted teeth and application of low-level laser therapy (LLLT) for acceleration of orthodontic tooth movement. In this paper, the authors present treatment of an impacted and dilacerated maxillary central incisor with laser application for its surgical exposure and LLLT for acceleration of its orthodontic traction and eruption.

Keywords: Tooth, Impacted; Lasers; Low-Level Light Therapy; Orthodontics; Surgery

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INTRODUCTION

Impaction of the permanent teeth is not commonly seen during the mixed dentition period, especially impaction of maxillary incisors. Among the incisors, the most prevalent impaction is seen in maxillary central incisors [1, 2]. There are various etiologic factors related to impaction of central incisors, such as supernumerary teeth, odontoma, and trauma. The most common cause is traumatic injury to the deciduous incisors [1, 3].

Disturbance in the eruption of anterior teeth will cause serious esthetic problems. Thus, treatment of maxillary incisor impaction is imperative [2]. Considering the possibility of alveolar bone resorption, it is preferred to preserve the impacted teeth instead of their

extraction, as much as possible.

Different factors such as position and inclination of impacted teeth, degree of dilaceration, and possibility of providing space for the impacted teeth are effective on the success of orthodontic-surgical treatment of impacted teeth [2]. The use of laser has been suggested in orthodontics and pediatric dentistry, and it has been applied for different treatments such as surgical exposure of impacted teeth [4, 5]. Application of laser for surgery will help decrease pain, edema, bleeding, and the need for local anesthesia for soft tissue laser surgery [6]. In addition, application of low-level laser therapy (LLLT) may provide an additional anesthetic effect, and is reported to accelerate the movement of impacted teeth [7-9].



Fig. 1. (A, B) Extraoral and (C-E) intraoral photographs before treatment

LLLT, also called photobiomodulation, has biostimulatory effects on bone regeneration and leads to acceleration of tooth movement by activating the proliferation of osteoclasts, osteoblasts, and fibroblasts [9, 10]. Numerous studies have confirmed the effect of LLLT on the velocity of tooth movement in rats [11] and also in humans [12-14].

The optimal parameters for orthodontic applications of LLLT have not yet been well established due to the great variations in parameters reported in the literature. Wavelength, power, energy density, and number of applications vary considerably. A recent literature review tried to find the most effective parameters [15].

Given the high importance of treatment of impacted maxillary central incisors, and considering the multiple advantages of laser application for surgical exposure and acceleration of orthodontic tooth movement, the aim of this study was to report successful treatment of an impacted maxillary central incisor with laser application beside surgical exposure and orthodontic traction.

Written informed consent was obtained from the patient and his parents for publication of this case report and the accompanying images.

CASE REPORT

A 10-year-old boy was referred to the Orthodontics Department of Shahid Beheshti Dental School with a chief complaint of delay in the eruption of an upper anterior tooth. The child was physically healthy, and extraoral and intraoral examinations were normal. His parents pointed to a history of trauma in the childhood.

Diagnosis:

The patient's facial pattern was symmetric with skeletal class I relationship (Wits=-2 mms, ANB=1°). Clinical and radiographic examinations revealed impaction of the maxillary right central incisor (Figs. 1 and 2), which was horizontally positioned with a dilacerated root on cone-beam computed tomography scan.

Dentally, the molar relationship was class I, with mild crowding in the upper and lower arch.

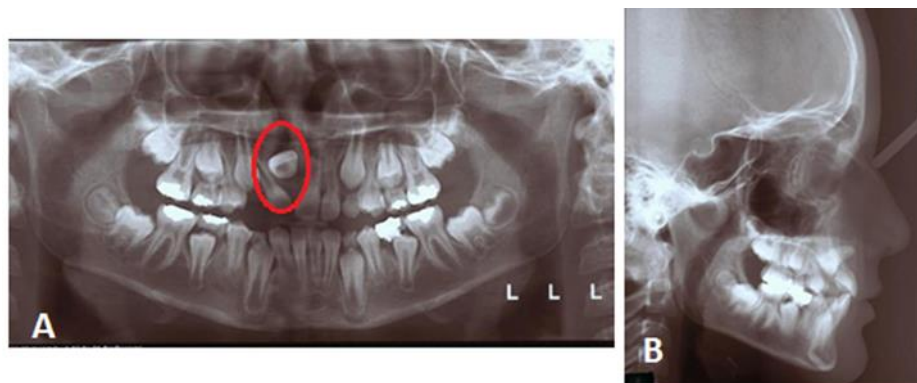


Fig. 2. (A) Panoramic radiograph showing the impaction of upper right central incisor, (B) lateral cephalometric radiograph

The upper dental midline was deviated due to drifting of the adjacent teeth, especially the upper right lateral incisor towards the missing area.

Treatment objectives:

1. To provide space in the maxillary arch for the eruption of impacted tooth
2. Orthodontic traction of impacted tooth after surgical exposure
3. To create acceptable occlusion after eruption of impacted tooth
4. To gain proper attached gingiva and normal appearance of maxillary anterior tooth

Treatment alternatives:

1. Surgical extraction of the impacted tooth, and regaining and maintaining space for prosthetic restoration
2. Surgical extraction of the impacted tooth and space closure through orthodontic treatment

Treatment Procedure:

In the first phase, brackets were bonded on all permanent teeth. After leveling and alignment of the upper arch and providing enough space for the impacted tooth, a relatively rigid stabilizing archwire (0.017 × 0.025-inch stainless steel) was placed.

Then, periodontal surgery was performed for exposure of the tooth. The crown of the tooth was impacted within the soft tissue; thus, there was no need for bone removal.

The procedure was conducted by a 975-nm pulsed laser (Laser HF® Standard, Hager

Werken, Duisburg, Germany) with 3 W power and duty cycle of 50% with a fiber diameter of 0.4 mm (Fig. 3).

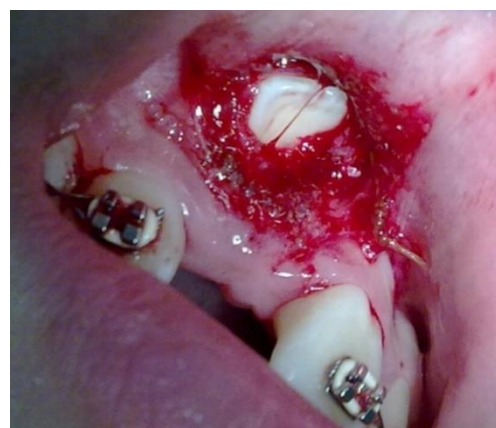


Fig. 3. Open exposure of impacted tooth through 975-nm pulsed laser (Laser HF® comfort, Hager Werken, Duisburg, Germany) at 3 W

The irradiation time was 150 s. After removal of the soft tissue, the attachment within a tied ligature wire was bonded to the facial surface of impacted tooth. There was no bleeding, edema or pain after surgery, and the patient reported no discomfort. After surgery, the patient was recalled for 3 sessions every month for surgical removal of the overgrowth of the gingiva and soft tissue over the tooth crown by using the same laser. Immediately after the exposure, light extrusive force (approximately 60 to 90 g) was applied by an elastomeric chain attached to the extension of the ligature wire.

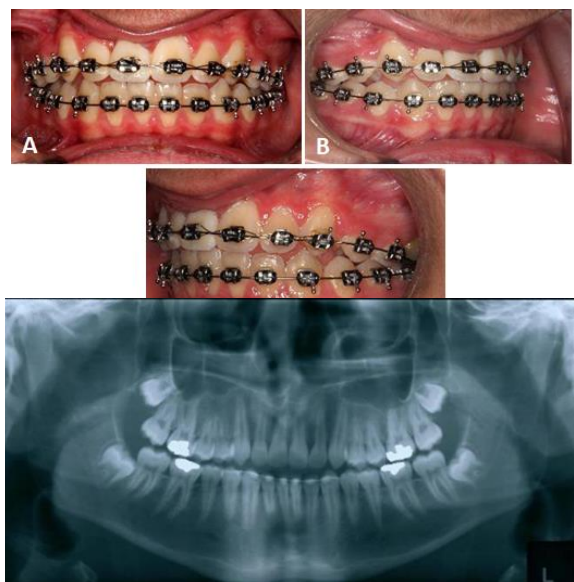


Fig. 4. (A-E) Intraoral photographs at 15 months, showing successful eruption of the impacted tooth with optimal leveling and alignment and esthetically pleasing gingival margin

Laser with 975 nm wavelength was primarily used for surgical exposure. This wavelength has limited depth of penetration and is not traditionally used for biostimulation. However, each surgical laser has a halo of decreasing light intensities and in the periphery, the biostimulatory effects may occur [16]. The main effect of LLLT, however, was targeted with the pulsed 100 mW, 660 nm laser probe, with distance from the soft tissue. The aperture of the probe was 0.125 mm² (diameter of 0.4 mm) and the gradually scanned area was 7 cm² at the labial and lingual sides. Laser was irradiated for 150 s in each session, resulting in 15 J energy and approximately 17 J/cm² energy density. The patient received LLLT monthly until acceptable movement of the impacted tooth was achieved, which took 6 sessions to occur. The 975 nm InGaAs diode laser (Laser HF® Standard, Hager Werken, Duisburg, Germany) that was used for surgery has secondary effects on bone regeneration and acceleration of tooth movement. During the surgery, the InGaAs laser was irradiated for 150 s (generally 120-180 s). In depth of bone, more than 25 J/cm² would be absorbed because this wavelength has high penetration in bone.

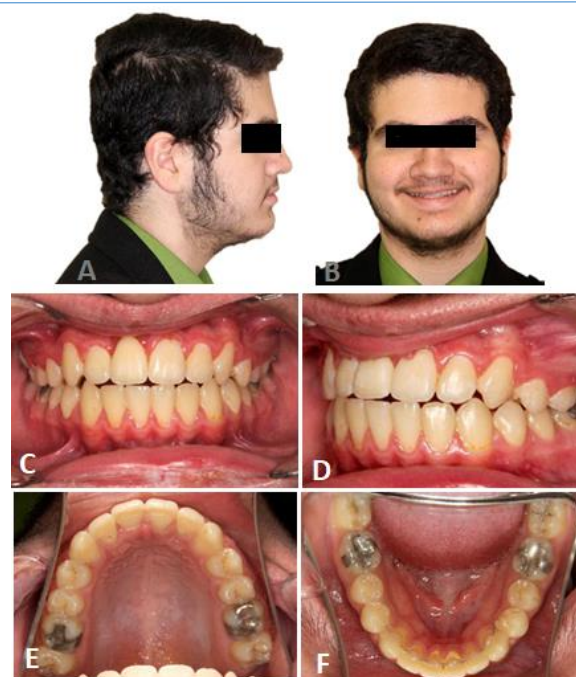


Fig. 5. After orthodontic treatment: (A, B) extraoral photographs, (C-F) intraoral photographs

A 660 nm red diode laser was irradiated at the same time with the same fiber with 100 mW power, which was responsible for the effect of LLLT. Therefore, a combination of 975 nm (more than 25 J/cm²) and 660 nm (12-18 J/cm²) laser was received by the tissue at the time of surgery and during the monthly recalls.

The impacted tooth was in relatively proper position after 7 months. The active treatment took 18 months. The final leveling and alignment was achieved by 0.018 × 0.025-inch stainless steel archwires (Fig. 4).

The maxillary left central incisor was brought to the appropriate position, and the upper and the lower arches were coordinated with class I canine and molar relationship.

The patient's smile was dramatically improved, and the final appearance of the anterior teeth and their gingival margins were esthetically pleasing. Also, cone-beam computed tomography radiographs taken at the final stage revealed no bone resorption and minimal root resorption. The position of the root and crown of the tooth was appropriate.

Improvement of the smile arc and good

occlusal relationship were observed after treatment (Figs. 5 and 6). Unfortunately, due to migration of patient and his family to a foreign country, debonding was performed 2 years after cessation of the active treatment and the final records were taken at the mentioned time.

Fig. 6. Final panoramic radiograph

DISCUSSION

Impaction of the anterior teeth can cause serious esthetic and subsequent psychological problems for patients during the mixed dentition period. Impaction of central incisors is less frequent than other teeth but is more serious [2].

This paper aimed to describe the successful treatment of a 10-year-old boy with an impacted maxillary left central incisor. The exposure of the tooth was performed by laser irradiation, and LLLT was used during orthodontic traction to accelerate tooth movement. Eventually, the tooth was positioned properly in the maxillary arch with acceptable occlusion and esthetically pleasing appearance. In this patient, we had to finish the treatment with a minimum overjet and overbite and proclination of lower incisors at the end of orthodontic treatment, because of Bolton discrepancy and taking caution to prevent root resorption in upper incisors. Considering the remarkable improvement in the smile arc, we decided to compromise them. Previous studies by Pinho et al, [1] and Bayram et al, [2] both evidenced successful treatment of impacted central incisors treated by surgical exposure and orthodontic traction. Furthermore, Lin [17] succeeded to treat a horizontally impacted and dilacerated maxillary central incisor through two stages of surgical exposure and orthodontic force with final proper occlusion.

In our study, exposure of the impacted teeth was conducted by irradiation of 975 nm laser to facilitate painless surgery without the use of local anesthesia and to decrease post procedural pain, bleeding, and edema [18]. Asgari et al, [6] also reported surgical exposure of a maxillary central incisor

impacted within the soft tissue through sequential 0.25 W, 0.5 W and 0.75 W soft tissue laser irradiation and exhibited successful results. The patient reported no pain and discomfort after surgery. Also, impacted incisors began to erupt to their proper position after surgery. More clinical trials are needed to establish the optimal wavelength and settings of laser for safe and efficient surgical use.

In the present study, the patient received LLLT at the same time at monthly recalls to induce tooth movement. LLLT is suggested to accelerate bone remodeling via increasing osteoclastogenesis at the pressure side during orthodontic tooth movement by stimulation of RANK/RANKL system and macrophage colony-stimulating factor [11]. Machado et al. [19] reported treatment of an impacted maxillary central incisor by LLLT at 780 nm wavelength and 35 J/cm² energy density immediately after surgical exposure and also 24 and 48 h after surgery. They reported that the patient had no pain after surgery and eruption of the impacted tooth occurred after 6 months, which confirms the acceleration effect of LLLT. In the present case, the movement of impacted tooth into its proper position took 7 months, which suggests the influential effect of LLLT. Surgical tissue removal by 975 nm laser was associated with LLLT with 669 nm wavelength and 12-18 J/cm² dosage in this study, which was close to the recommended dosage in previous studies [13, 20].

For post-surgical pain reduction, infrared LLLT has been well documented as monotherapy after application of brackets. For rapid bone remodeling, lower doses and frequent irradiation sessions have been recommended [15]. In the current case, 975 nm surgical laser had some additional biostimulatory effects [21]; while, the 660 nm red laser light promoted initial wound healing and velocity of tooth movement. Use of red laser light for this purpose is not common but has been previously reported [22]. The most pronounced effects of LLLT are seen during the first phases of healing.

The acceleration effect of LLLT during

orthodontic tooth movement has been confirmed in previous studies. Yoshida et al. [11] showed that the amount of tooth movement was significantly greater in rats who received LLLT as compared with the control group without laser irradiation. Other in vivo studies, evaluating the rate of tooth movement in humans, supported the same results and recommended LLLT during orthodontic treatment, which is consonant with the result of our study [10, 12-14, 23]. In contrast, Seifi et al. [24] examined the amount of tooth movement in rabbits after LLLT at 630 nm and 850 nm wavelengths and showed opposite results and claimed that LLLT caused a reduction in the speed of tooth movement. Also, a randomized clinical trial with split-mouth design evaluated the effect of LLLT on the rate of orthodontic tooth movement and found no significant difference between the irradiated and non-irradiated sides [25]. Thus, considering the controversy on the effects of LLLT and lack of enough evidence in this context, the results of relevant studies should be interpreted with caution. A closer analysis of all relevant laser and clinical parameters is needed to reach a final conclusion regarding the effects of laser.

CONCLUSION

Combining laser irradiation for surgical exposure of impacted teeth and LLLT for acceleration of tooth movement may provide a successful approach for treatment of impacted teeth, especially with dilacerated roots, and can bring about good prognosis for such teeth. Improved periodontal, occlusal and esthetic results might be achieved, especially in young patients.

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CONFLICT OF INTEREST STATEMENT

None declared.

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