Case Report

Low-level laser therapy effects in traumatized permanent teeth with extrusive luxation in an orthodontic patient

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ABSTRACT The aim of this case report was to present and evaluate the effect of low-level laser therapy on traumatized permanent teeth with extrusive luxation in an orthodontic patient. The treatment and follow-up evaluation of two orally luxated maxillary permanent central incisors in a 19-year-old man is described. Detailed anamnesis was taken, and extraoral, intraoral, radiographic examinations and electrical and thermal pulpal tests were performed to determine the type of the luxation and the further treatment protocol. Teeth were splinted with composite resin, and antibiotic therapy was prescribed. Low-level laser therapy was applied for 25 sessions. No root canal treatment was applied to the teeth. Continuation of the orthodontic treatment was restarted after 6 months. No sign of clinical or radiographic pathology was detected after 2 years from the end of the treatment. Teeth were identified healthy and sound without any root canal intervention. Treatments with low-level laser applications may be evaluated as noninvasive alternative treatment options in comparison with endodontic treatment for teeth with extrusive luxation more than 2 mm, especially for those who have orthodontic treatment needs. (Angle Orthod. 2010;80:968–974.)

KEY WORDS: Low-level laser therapy; Extrusive luxation; Orthodontic treatment

INTRODUCTION

The emergency treatment of a traumatically injured tooth occurs frequently in a general dental practice. Traumatic injury to a permanent central incisor is a common occurrence in childhood and adolescence. The maxillary central incisors are the most affected tooth in both primary and permanent dentition injuries. The maxillary arch is involved in a higher percentage of trauma cases (95.72%). The most common cause of injuries is falls (67.34%). In the primary dentition, the most common type of injury is extrusive luxation (38.23%), and in the permanent dentition, fracture of enamel and dentin without pulp involvement is most common (50.5%).

The anterior teeth are both functionally and esthetically important. Fracture of such teeth can affect the appearance of an individual and the ability to eat properly. Epidemiological studies worldwide on traumatic injuries to anterior teeth in children show that the prevalence is relatively high, with more boys affected than girls. The incidence, predisposing factors, etiology, classification, clinical features, treatment modalities, and complications of traumatic injuries to anterior teeth in children have been studied. Risk of incisor injury was reported to be greater for children who have a prognathic maxilla, a history of trauma, greater overjet, and mandibular anterior spacing.

Luxation injuries can be classified as intrusive, extrusive, and/or lateral; this categorization further facilitates the mode of splinting and repositioning used during treatment. Luxation traumatic injuries affect the hard tissues and may involve periodontal tissues in severe cases. Periodontal healing must be considered during treatment of traumatic injuries that result in total luxation of the teeth.

Complications that have been reported include pulpal necrosis, apical radiolucencies, partial or total pulp calcification, root resorption, marginal periodontal bone breakdown, and arrested or disturbed root development. The incidence of pulp necrosis in permanent teeth with open apices after periodontal...
tissue injuries was reported as 8%, while in teeth in which the apical foramen is closed, this ratio was reported as 38%.\textsuperscript{12} The frequency of pulpal necrosis for extrusive luxation was 26% according to the same study.\textsuperscript{12} Endodontic treatment is indicated when the clinical and radiographic symptoms of root canal infection—periapical pathology, external root resorption, fistula development, and sensitivity to percussion—are detected after dental trauma.

There is need to review the various aspects of this subject and update the treatment technique.\textsuperscript{4} Despite more than 30 years of experience with low-level laser therapy (LLLT) or biostimulation in dentistry, concerns remain as to its effectiveness as a treatment modality.\textsuperscript{13} Controlled clinical studies have demonstrated that LLLT is effective for some specific applications.\textsuperscript{13}

Although LLLT has a wide range of area of usage, no clinical studies regarding its use in dental traumatology, luxation, and its long-term follow-up have been reported. Thus, the purpose of this study was to present and evaluate the effect of LLLT on traumatized permanent teeth with extrusive luxation in an orthodontic patient.

**CASE REPORT**

A 19-year-old male patient applied to the Oral Diagnosis and Radiology Department of Dentistry Faculty following dental trauma (Figure 1a). An informational consent form was obtained.

The patient reported that he had fallen during a soccer game and hit his upper anterior teeth on the ground. During his detailed anamnesis, no loss of consciousness was detected. The patient reported that he did not have any systemic diseases and was being treated with fixed orthodontic treatment due to his Class 1 anterior open bite.

Swelling in the upper lip, tearing in the right corner of the upper lip, and a scratchlike injury on the left side of the lower jaw was detected during the extraoral examination. No pathologic symptoms were detected during the examination of either the temporomandibular joint or the bone structures. During the intraoral examination, bleeding in the gingival sulcus of the upper anterior incisor teeth was discovered. Teeth 21 and 22 had been subjected to extrusion luxation, displaced slightly from their sockets, were highly mobilized, and were sensitive to percussion. On the other hand, although it was diagnosed that teeth 11 and 12 did not show any displacement, they were found mobile and sensitive to percussion. Subluxation was the diagnosis for these teeth.

The pulpal status of the teeth needed to be assessed, and a negative response was obtained from all of the examined incisor teeth for their vitality using electrical and thermal pulpal tests. An electrical pulp tester (Digitest, Parkell, NY) and solid carbon dioxide (CO\textsubscript{2} ice) were used for these vitality tests. In addition, no dental hard tissue fractures were detected. However, it was observed that the orthodontic fixed appliances of teeth 12, 21, and 22 were debonded after the trauma. Widening was observed in the periodontal space in the apical regions due to coronal displacement of teeth 21 and 22, although no root fracture was detected in the relevant teeth in the radiographic examination (Figure 2a–c).

Initially, laceration located in the upper lip was sutured under local infiltration anesthesia. Teeth 21 and 22, with extrusive displacement, were repositioned shortly after the injury with the help of finger pressure. A composite resin splint was applied canine to canine involving all teeth from 23 to 13 (Figure 1b). Oral hygiene instructions and antibiotic therapy were prescribed.
A decision was made to use a gallium-aluminum-arsenide (GaAlAs) diode, low-level laser system (RJ Lasers, Vienna, Austria) for the treatment. The unit had a contact probe with a focus dimension of 1 mm$^2$ with an elliptical standard. The system delivered a 25-mW output that emits a wavelength of 655 nm. The irradiance used was 2.5 J per treatment site; that is, the deposited energy density was 2.5 J/cm$^2$ per dental element, which was delivered in a continuous wave mode with contact on the region of the applied area, from the apical level of the buccal and palatal surfaces of the patient’s traumatized teeth, for 100 seconds each, in every session. LLLT was applied as six consecutive sessions initially. Later, nine sessions were applied with a 1-day interval between sessions. After a 15-day interval, 10 consecutive sessions were applied. The total number of sessions applied was 25 (Figure 3a,b). The operator and the patient wore laser-protective eyewear specific to the diode laser’s wavelength during the treatments. Sutures in the upper lip of the patient were removed after 1 week. The composite resin splint was taken off after the end of the third week and a decrease in mobility was detected.

The patient was taken into follow-up, where clinical inspections, vitality evaluations, and radiographic examinations were performed for the relevant teeth in the control appointments after 1 month (Figure 4a,b), 3 months (Figure 5a,b), 6 months (Figure 6a,b), and 2 years (Figure 7a,b) from the end of the treatment.

After the end of the LLLT, positive responses were obtained with the help of pulpal vitality tests for every incisor teeth in which negative responses were obtained just after the dental trauma. Furthermore, no color change in the crowns of the related teeth was observed. Symptoms such as sensitivity to percussion or spontaneous pain were not detected clinically, and
no resorption was found either in the root or bone structure in radiographic examinations.

The orthodontic treatment was restarted after 6 months. No sign of clinically or radiographically defined pathology concerning tooth structures was detected after 2 years from the end of the treatment. The teeth were identified as healthy.

**DISCUSSION**

Proper management of permanent incisors includes careful diagnosis, continued reevaluation, and a conservative treatment approach. Both the location of the root fracture and pulpal vitality status play important roles in proper treatment decisions. Multi-disciplinary care involving pediatric dentistry, orthodontics, or oral and maxillofacial surgery may be indicated. Because poor primary management of dental trauma may have lifelong consequences for the young patient, it is important to provide appropriate care to ensure an optimum short- and long-term outcome for injured teeth.

Extrusion luxation in the maxillary left central and lateral incisor teeth and subluxation in the maxillary right central and lateral incisor teeth were detected in this case report, in which the patient demonstrated periodontal tissue injury. In case of extrusive luxation, pulpal tissues and the periodontal ligament are injured. When tooth mobility is increased, flexible splinting should be considered. Repositioning and splinting of the tooth are necessary.

Treatment after the extrusive type of luxation in permanent teeth generally is composed of gently repositioning the tooth to its original position and then splinting the tooth for 2 to 3 weeks. Endodontic
treatment is indicated before tooth resorption begins for teeth that do not respond to pulpal vitality tests after 2 to 3 weeks. Mild movements at the apical of the immature teeth with wide apical endings can prevent damage of vascular-neural structures, and revascularization can be obtained. In mature teeth with closed apices displaying prominent extrusion (more than 2 mm), the need for endodontic treatment is almost certain. A high incidence of pulpal necrosis was reported in the case of extrusive injuries. No active treatment is necessary after this kind of injury. One to 2 weeks of tooth splitting is advised if a prominent mobility is detected. The necessity of beginning an endodontic treatment has been advised when pathological changes are detected during radiographic follow-up continuing for at least a year. Color change in the crown, negative response to vitality tests, and periapical radiolucency are classical symptoms of pulpal necrosis. Spontaneous pain, sensitivity to percussion, or occlusion are symptoms that can be related to pulp necrosis.

However, clinical and radiographic parameters should also be evaluated during diagnosis, as pulpal necrosis that develops after luxation injuries can be asymptomatic. The healing capacity of young pulpal tissue is much higher. A negative response can be obtained for electrical stimulants during initial examinations of most traumatized teeth. It was reported that sensitivity is mostly regained in teeth with subluxation injuries. A change from negative to positive responses is also detected in teeth with luxation injuries, although more rarely. A single negative response should not be detected as a necrosis. Endodontic treatment should be delayed at least until another clinical and/or radiographic symptom of necrosis is detected.

Endodontic treatment is necessary after extrusive luxation of a tooth with completed root formation. Healing of the periodontal ligament will determine prognosis. When a normal ligament is obtained during healing, the tooth can be preserved for a long period. When progressive replacement resorption (ankylosis) develops, most teeth can remain in position for about 10 years. When inflammatory resorption develops, the tooth will be lost within a short time.

Figure 6. Periapical radiographic images after 6 months.

The wound-healing mechanism for LLLT was reported previously. Studies on wound healing and pain relief are highlighted to show the clinical efficacy of laser therapy. In examining the effects of LLLT on cell cultures in vitro, some articles report an increase in cell proliferation and collagen production. Although there have been several studies that have addressed the action of LLLT on bone repair, osteogenesis, pulp tissue, and the dentin repair process, there are no reports on its effects on teeth displaying periodontal tissue injury during orthodontic treatment.

It was decided that LLLT should be used in this case as a supplementary treatment originally, in view of these reported developments and effectiveness on wound healing, bone repair, and osteogenesis. However, the fast occurring healing observed in the patient caused a change of mind, and the authors decided not to perform endodontic treatment and to continue with only the LLLT treatment.
Abi-Ramia et al., who studied the effects of LLLT and orthodontic tooth movement on dental pulps in rats, reported that LLLT leads to a faster repair of the pulpal tissue due to orthodontic movement. Orthodontically induced tooth movement associated with LLLT produced an increase in the vascularization, and this factor could accelerate pulp tissue repair. Ozen et al. reported that LLLT appears to be more beneficial as it is noninvasive when reducing long-standing sensory nerve impairment. However, therapeutic and patient-related factors should be discussed using data from longitudinal clinical studies. There is much to be learned about the mechanisms and how to properly use these cellular phenomena to reach treatment goals. Also, the importance of standard parameters is emphasized for the applications of low-intensity lasers in biology and medicine.

LLLT may result in long-term retention of many of these traumatized teeth. After 2 years, no clinical or radiographic pathology was detected in the teeth and in the surrounding tissues in this case (Figure 7a,b). It may be concluded that extruded mature permanent teeth can spontaneously heal, conserve their vitality, and continue their duty both functionally and esthetically without any surgical or endodontic management. Moreover, teeth can even overcome the orthodontic therapy needs after the LLLT treatment. In this case, orthodontic treatment was continued successfully after 6 months. Findings of acceleration of new vascularization, changes in cell proliferation, increases in cellular proliferation of periodontal ligament cells, and higher expression of fibroblast growth factors in the periodontal tissue as reported in studies regarding low-power laser irradiation–associated orthodontic tooth movement might have played a role in the findings of this current study.

It has been reported that teeth with severe periodontal injury during orthodontic therapy and subsequent total pulp obliteration have an increased risk of pulp necrosis during additional orthodontic treatment stages. According to the results of this study, LLLT may be thought as an alternative treatment option and may have an additional therapeutic effect for this kind of teeth with periodontal injury during orthodontic treatment, since there were no signs of pulpal and/or periapical pathology during treatment and at 2-year follow-up. Controlled clinical studies including a larger number of trauma cases regarding this subject are needed.

CONCLUSION

- Treatments with low-level laser applications may be evaluated as noninvasive alternative treatment options in comparison with endodontic treatment for teeth with extrusive luxation greater than 2 mm.

REFERENCES


