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Clinical Efficiency of Diode Lasers (810+980nm) in Exposure of Maxillary Impacted Canines

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Abstract

Objective: An impacted canine has no eruption following the completion of the normal growth pattern. To expose an impacted canine, a laser can be used as an additional tool in addition to a scalpel and electrocautery. To compare the effectiveness of a dual diode laser with a traditional scalpel procedure for exposing impacted canines, with the parameters of bleeding and pain as main outcomes.

Methods: Thirty patients were chosen for this investigation. Each of them needed an operation for canine impaction, and they were divided into two groups at random: the study group, which were treated with a dual diode laser (980+810nm), and included fifteen patients, and the control group, which were treated with a scalpel. Data obtained prior to, during, and following surgery were compared. There were follow-ups after two hours, on the second, and third days after surgery. The Student's *t* and the one-way ANOVA tests were used for all comparisons.

Results: Thirteen males and seventeen females were examined in this study, and their mean age was 23 years. Intraoperative bleeding score showed a significantly decrease in laser group versus the surgical blade group (0.4666 vs. 0.29333, P=0.001). The postoperative pain score was significantly decreased in the laser group compared to the surgical blade group, at two hours (4.6 vs 8.233, P = 0.001), two days (2.067 vs 4.833, P=0.001), and three days (1.066 vs 2.01, P=0.001). There were significant differences in the pain and bleeding scores (P≤ 0.05).

Conclusion: When using a dual diode laser (810+910nm) as opposed to a scalpel, hemostasis can be achieved with minimal pain.

Keywords: Impacted Canine; Dual Diode Laser; 810+980nm; Scalpel.

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Introduction

A tooth that does not erupt after the regular development pattern is finished is known as an impacted tooth [1]. After the third molar teeth, maxillary canines are the teeth that are impacted most frequently. Pediatric, orthodontic, or general dentists frequently identify tooth impaction during routine dental examinations. Results that are both aesthetically pleasing and practical can be achieved with early discovery, prompt management, and appropriate surgical and orthodontic intervention. Impacted canines may result in undesirable complications such as cyst formation and neighboring incisor resorption [2]. Radiographs such as OPG (Orthopantomogram) or CBCT scan (Cone beam computed tomography) assist in identifying impacted canines in the anteroposterior position regarding the adjacent teeth [3]. Classification of maxillary canine impaction includes Type III (distally tipped canine with an overlapped canine crown and the root of the first premolar); Type I (canine submerged between lateral incisor and first premolar); Type II (crown is mesially tipped overlapping, pressing lateral incisor tooth to provide a distal tipping of the lateral); canine long axis orientations are Type IV/V (horizontally oriented); Type VI (canine crown directed upward into orbital fossae); and Type VII (horizontally oriented canine

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long axis with crown situated buccally or interchanging with adjacent teeth) (Figure 1) [4]. To develop and carry out the appropriate flap design, as well as orthodontic devices, it is essential that oral surgeons and orthodontists understand the location and angulation of the maxillary impacted canine. It is suggested that only the tissue above the crown of an impacted canine tooth is removed using a laser or conventional surgery for Types I, II, and III impacted canine teeth. If bone is present, it can be removed with a round handpiece and normal saline irrigation to avoid the bone from heating up. There are three methods for exposing impacted canines: laser, electrosurgery, and scalpel. The most popular technique for canine exposure is still the conventional method, which uses a scalpel. This method has the advantage of being less expensive and having a more durable instrument, but it may be difficult to achieve hemostasis [5–9]. By simultaneously closing blood vessels and cutting, electrocautery can produce excellent hemostasis; nevertheless, excessive heat generation can result in thermal damage, which can cause healing to be delayed relative to scalpel surgery [9,10]. In contrast to patients exposed with a scalpel in a typical manner, those exposed with a laser exhibited fewer local anesthetics during surgery, less discomfort following surgery (requiring fewer analgesics), and no post-operative symptoms, such as pain, oedema and bleeding [10-13]. The fiber-optic tip of the diode laser device cuts, ablates, and reshapes the oral soft tissues more easily than a scalpel can [14]. There is no or minimal discomfort, bleeding, or suturing required when using the laser [15-18]. It provides several advantages for the treatment of soft tissue diseases that conventional surgery does not [19]. This is mostly because the deep penetration of the laser into the surrounding tissues, which promotes the growth of new tissue and cell growth without altering the temperature of the surrounding tissues permanently (photobiomodulation) [17]. Since diode lasers are easily absorbed by pigments such as hemoglobin and melanin, they are becoming more and more popular in periodontal surgery. This is because they are safe to use near dental hard tissues due of their poor absorption by water and hydroxyapatite [20].

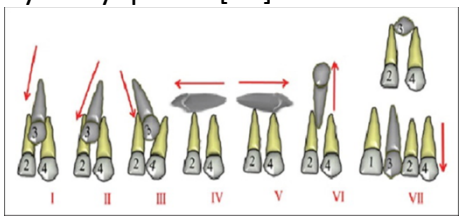

Figure 1. Yamamoto et al. [4] classification of canine maxillary impaction. First premolar, canine, and lateral incisor are represented by teeth 2, 3, and 4, respectively.

Methods

For this investigation, thirty patients older than 16 years were chosen. They were separated into two groups at random: the control group, which included fifteen patients treated with a scalpel, and the study group, which included fifteen patients treated with a dual diode laser (980+810nm). All of them needed surgical treatment for maxillary canine impaction, either buccal or palatal. All patients did not have concomitant medical issues. Patients who were pregnant or otherwise physically compromised were not included in this study. Patients that were treated at the Department of Surgery, Al-Kadhimiya Teaching Hospital were treated with dual diode laser applied at wavelength 810+980nm, 2.5W power, continuous wave mode with a 400 µm tip diameter. Whereas the patients treated Al Amriya Specialized Dental Center were treated with the scalpel method. Prior to surgery, all patients had medical history, dental history, clinical examination (extraoral and intraoral examinations), OPG (orthopantomogram), or CBCT scan (cone beam computed tomography) done to determine the location of the tooth and see whether there was bone covering the impacted tooth. Pain, edema,

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and healing were recorded using follow-up scores on the first-, second-, and fifth-days post-surgery as well as the first- and second week following surgery. The research received ethical approval on September 21, 2023, with decision 435 from the Laser Institute for Postgraduate Studies' Research Ethics Committee at the University of Baghdad. Following the exposure of the impacted canines, an orthodontist attached a bracket.

Exposure of Impacted Canine by Scalpel

The treatment was performed under local anesthetic. Cone-beam computed tomography systems (CBCT) were used to identify the location of the impacted tooth and whether it was covered by bone. After that, a surgical tool (a blade) was used to create a window and expose the impacted tooth. If bone was present, it was removed surgically using a round bur and continuously irrigation with saline to prevent the bone from heating up. Then, irrigation of surgical site by normal saline was done (Figure 2) [21].

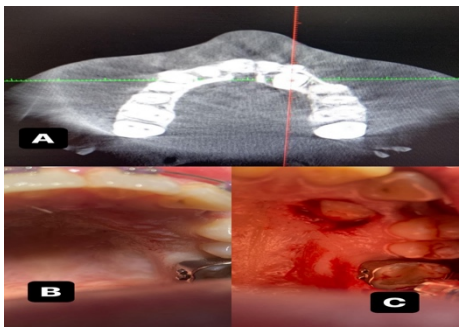

Figure 2. Exposure of impacted canine by conventional surgery (scalpel). A CBCT, B. Before exposure, C. After exposure.

Exposure of Impacted Canine by Dual Diode Laser 810+980nm

There were fifteen patients in the laser canine exposure study group. The process was carried out with a high-intensity laser called QuickLase810+980 nm (Canterbury, United Kingdom). Before the fiber end has been carbonized and initialized, the new laser fiber tip will not cut. Using a piece of back carbon paper to start lasing is the simplest way to accomplish this. Articulating paper was used to initiate the fiber tip. The patient, the assistant, and the operator were all wearing safety glasses. Avoiding instruments with highly reflective or mirrored surfaces was advised due to the possibility of laser beam reflection. Care was taken to ensure that the laser was not used close to explosive gases. Local infiltration was used to achieve anesthesia (2 percent lidocaine with 1:100:000 epinephrine). Laser dots were used to define the surgical area. The procedure began after determining the location of the tooth and if covered by bone or not by cone-beam computed tomography (CBCT). Then, the impacted tooth was exposed using dual diode laser (wavelength 810+980nm), power 2.5W, a continuous mode energy output of 60mJ, and an optical fiber diameter of 400 µm. Fiber tip in contact mode and sweeping brushstroke motions were used to cut tissue to make a window in the place of the impacted canine tooth, and then bone coverage if present was removed by surgical round bur with irrigation by normal saline to avoid heating the bone After that, the orthodontist placed a brace on the canine tooth until it pulls it to its natural place .The surgical site was irrigated with normal saline (Figure 3).

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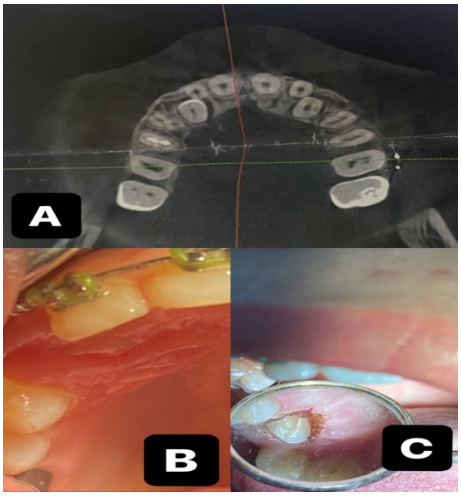

Figure 3. Exposure of impacted canine by laser. A. CBCT, B. Before exposure, C. After exposure.

Statistical Analysis

SPSS, version 21.0, France, was used to analyze the data. To compare numerical variables, one way ANOVA and Student's t-test were employed. P≤ 0.05 was used as the significant level.

Results

Bleeding Score (WHO Bleeding Scale) [22]

Table 1. Statistical analysis of bleeding score after exposure of impacted canines.

Intraoperative bleeding score showed significantly lower scores in laser group versus the surgical blade group (0.4666 vs. 0.2.9333, P=0.001) (Table 1).

Post-operative Bleeding score	N	Means	SD	SE	Confidence interval (CI) 95%	P -value
Diode laser	15	0.4666	0.639	0.1652	0.1122 -0.8210	<.000
Scalpel	15	2.9333	0.258	0.0666	2.7903-3.07631	

Pain Score (Visual Analogue Scale, VAS) [23]

When comparing pain scores between laser and surgical groups, laser had lower scores two hours after operation, two days after, and three days after (Table 2).

Table 2. Pain scores at two hours, two days, and three days after operation.

Post-operative pain	Exposure canine surgery		P value
	Scalpel	Diode laser	
	Mean±SD	Mean±SD	
2 hours	8.233±0.903	4.6±1.055	<.0001
2nd day	4.833±0.227	2.067±0.22	<.0001
3rd day	2.01±0.188	1.066 ±0.188	0.0016

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Discussion

The intraoperative and postoperative benefits of dental lasers have resulted in its application in oral soft tissue surgery [24]. The purpose of this study was to determine if treatment exposure of an impacted canine based on two parameters—pain and bleeding—allows the dual diode laser to be more effective than the conventional scalpel procedure.

Each case treated by the diode laser had less post-operative bleeding and pain at all times assessed in addition to excellent hemostasis and a clear view of the surgical field. Hemostasis is enhanced by the contraction of the irradiated tissue against the proximal vasculature and the shrinkage of collagen in blood vessel walls. Increased platelet aggregation was seen in erythrocytes damaged by lasers, which promotes intraluminal thrombosis and reduces blood loss [10]. Melanin and hemoglobin greatly absorb diode lasers. This enables deep penetration, precise cutting of soft tissue with great homeostasis, and laser treatment of all cases without bleeding [8,25]. These results use the same bleeding scores and are consistent with previous reported data [8]. All cases treated with the diode laser had considerably lower post-operative pain compared to conventional surgery, which was also consistent with previous data [8].

Conclusion

In conclusion, when compared to scalpel surgery, dual diode laser 810nm+980nm surgery demonstrated efficacy as an alternate approach in the exposure of impacted canines with excellent hemostasis and decreased postoperative pain. The advantages of using lasers include improved patient compliance, less discomfort, no infection or need of post-operatory medication, bloodless and sterile field, faster healing, swift operation, fewer appointments and treatment duration. Nonetheless, is desirable that clinicians understand the physics of lasers, their safety, and how they interact with tissue.

Conflicts of interest

The authors declare no competing interests.

References

1. Lazim AI. The prevalence of impacted maxillary canine among Iraqi patients of Al-Basrah city. Journal of the College of Dentistry, University of Baghdad. 2016 Mar;325(3154):1-5.

2. Rahman VF, Fatah AA. Localization of maxillary impacted canine using cone beam computed tomography for assessment of angulation, distance from occlusal plane, alveolar width and proximity to adjacent teeth. Journal of Baghdad College of Dentistry. 2017 Mar 13;29(1):70-5.

3. Warford Jr. JH, Grandhi RK, Tira DE. Prediction of maxillary canine impaction using sectors and angular measurement. American Journal of Orthodontics and Dentofacial Orthopedics 2003;124(6):651-655.

4. Yamamoto G, Ohta Y, Tsuda Y, Tanaka A, Nishikawa M, Inoda H. A new classification of impacted canines and second premolars using orthopantomography. Asian J Oral Maxillofac Surg. 2003;15:31-7.

5. Fornaini C, Rocca JP, Bertrand MF, Merigo E, Nammour S, Vescovi P. Nd: YAG and diode laser in the surgical management of soft tissues related to orthodontic treatment. Photomedicine and Laser Surgery 2007;25(5), 381-392.

6. Sobouti F, Rakhshan V, Chiniforush N, Khatami M. Effects of laser-assisted cosmetic smile lift gingivectomy on postoperative bleeding and pain in fixed

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Vol 13 No 2 (2024) DOI 10.5195/d3000.2024.703

orthodontic patients: a controlled clinical trial. Progress in Orthodontics 2014;15(1), 1-5.

7. Matthews DC. Seeing the light-The truth about soft tissue lasers and nonsurgical periodontal therapy. Journal of the Canadian Dental Association 2010;76(2).

8. Ize-Iyamu IN, Saheeb BD, Edetanlen BE. Comparing the 810nm diode laser with conventional surgery in orthodontic soft tissue procedures. Ghana Medical Journal 2013; 47(3), 107-111.

9. Amaral MBF, De Ávila JMS, Abreu MHG, Mesquita RA. Diode laser surgery versus scalpel surgery in the treatment of fibrous hyperplasia: a randomized clinical trial. International Journal of Oral and Maxillofacial Surgery 2015; 44(11), 1383-1389.

10. Kumar P, Rattan V, Rai S. Comparative evaluation of healing after gingivectomy with electrocautery and laser. Journal of Oral Biology and Craniofacial Research 2015; 5(2), 69-74.

11. Qassab AH, Hamad SA. Comparison between diode laser and scalpel for lip lengthening in patients with gummy smile. Journal of Baghdad College of Dentistry 2019 Mar 15;31(1):60-4.

12. Al-Karadaghi TS, Gutknecht N, Jawad HA, Vanweersch L, Franzen R. Evaluation of temperature elevation during root canal treatment with dual wavelength laser: 2780 nm Er, Cr: YSGG and 940 nm diode. Photomedicine and Laser Surgery 2015 Sep 1;33(9):460-6.

13. Al-Karadaghi TS, Franzen R, Jawad HA, Gutknecht N. Investigations of radicular dentin permeability and ultrastructural changes after irradiation with Er, Cr: YSGG laser and dual wavelength (2780 and 940 nm) laser. Lasers in Medical Science 2015 Nov;30:2115-21.

14. Jawad HA, Hamdi SA. Non-anesthetic second stage implant surgery by 970nm diode laser. IOSR J Dent Med Sci Ver I. 2015;14(6):2279-861.

15. Migliario M, Rizzi M, Lucchina AG, Renò F. Diode laser clinical efficacy and mini-invasivity in surgical exposure of impacted teeth. J. Craniofac. Surg. 2016, 27, e779–e784.

16. Borzabadi-Farahani A. The adjunctive soft-tissue diode laser in orthodontics. Compend. Contin. Educ. Dent. 2017, 38, e18–e31.

17. Aoki A, Mizutani K, Schwarz F, Sculean A, Yukna RA, Takasaki AA, Romanos GE, Taniguchi Y, Sasaki KM, Zeredo JL, et al. Periodontal and peri-implant wound healing following laser therapy. Periodontol. 2000 2015, 68, 217–269.

18. Borzabadi-Farahani A, Cronshaw M. Lasers in Orthodontics. In Lasers in Dentistry—Current Concepts. Textbooks in Contemporary Dentistry; Coluzzi D, Parker S, Eds.; Springer: Cham, Switzerland, 2017.

19. Tawi SR, Ahmed SS, Algarak BS. Histopathological evaluation of two diode lasers 450 and 980 nm in excision biopsies of oral benign lesion. Lasers in Dental Science. 2023 Dec;7(4):251-8.

20. Al Ghazali SR, Ahmed SS, Abdulhameed BS. The clinical evaluation of oral fibroma lesion removal utilizing two types of diode lasers 980 nm and 450 nm. Iraqi Journal of Laser. 2024 Jun 15;23(1):80-9.

21. Björksved M, Arnrup K, Lindsten R. Magnusson A, Sundell AL, Gustafsson A, Bazargani F. Closed vs open surgical exposure of palatally displaced canines: surgery time, postoperative complications, and patients' perceptions: a multicentre, randomized, controlled trial. European Journal of Orthodontics, 2018;40(6), 626-635.

22. Webert KE, Cook RJ, Sigouin CS, et al. The risk of

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Vol 13 No 2 (2024) DOI 10.5195/d3000.2024.703

bleeding in thrombocytopaenic patients with acute myeloid leukaemia. Haematologica. 20 06;91:1530–1537.

23. Sung Y-T, Wu J-S. The Visual Analogue Scale for Rating, Ranking and Paired-Comparison (VAS-RRP): a new technique for psychological measurement. Behav Res Methods 2018; 50(4):1694–1715.

24. Akram HM, Ali OH, Omran NK, Ali AO. Diode laser versus scalpel gingivectomy. Biomedical and Pharmacology Journal 2017 Dec 21;10(4):1799-804.

25. Musaa FE, Awazli LG, Alhamdani F. Gingival enlargement management using diode laser 940 nm and conventional scalpel technique (A comparative study). Iraqi Journal of Laser 2017;16(B):1-9.