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The clinical evaluation of oral fibroma lesion removal utilizing two types of diode lasers 980 nm and 450 nm

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Abstract

There are a number of advantages to using diode lasers in oral surgery with varying wavelengths. Lasers offer several advantages, such as reduced recovery periods, the potential to combine tissue coagulation with surgical incisions, decreased discomfort, field disinfection, and a faster and more efficient healing process. These benefits result in a decreased reliance on medicine and enhanced patient comfort throughout the recovery phase. This includes a large AsxzwzA=increase in working efficiency at far lower power settings, among other things. As a result, unwanted effects can be greatly reduced. It also has a favorable effect on wound healing. The purpose of this study was to compare two diode lasers (450 and 980nm) to determine whether one is more effective at excision the oral fibroma lesion with less discomfort, no oedema, and faster healing. In this study, thirty-eight patients between the ages of 16 and 45 were included. The laser parameters setting for both wavelengths were a pulsed wave mode, tip diameter 400µm, and the initial wavelength applied at 1.3 W power. The current study demonstrated that the blue laser with a wavelength of 450 nm had more efficacy in excising the oral benign lesion. It exhibited reduced discomfort, decreased swelling, and rapid healing, as observed. The findings of this study indicate that the 450nm diode laser is superior in effectively eliminating the oral fibroma lesion in a clinical setting while causing minimal patient discomfort and almost no swelling. In contrast, the 980nm laser resulted in some discomfort and swelling that persisted for a longer duration. For such instances, the diode laser with a wavelength of 450 nm can be employed with greater effectiveness to eliminate the oral lesions.

Keywords: diode laser, wavelengths 450 and 980nm, clinical scores, oedema and pain.

1. Introduction

Oral benign lesions come in a variety of forms and might be the result of an isolated mouth discovery or a dermatological condition. The most frequent benign lesion of the oral mucosa is fibroma. Barker and Lucas devised criteria in 1967 to determine what constitutes a real fibroma. It is also referred to as an irritational fibroma, fibrous nodule or oral polyp, focal intraoral fibrous hyperplasia, and traumatic fibroma[1]. These oral lesions excised by several surgical techniques, including the use of electrosurgical scalpels,

conventional scalpels and lasers can be used to remove these lesions [2] Several different kinds of oral mucosal lesions can be diagnosed and treated using lasers, which are used by specialists in oral medicine. Frenectomies, epulis fissuratum, fibromas, gingival enlargements, gingivectomies, and specific crown lengthening procedures are just a few of the many procedures that can benefit from laser technology[3].

+-In oral surgery, lasers such as carbon dioxide (CO2), erbium-doped yttrium aluminum garnet (Er:YAG), neodymium-doped yttrium aluminum garnet (KTM, Nd:YAG), and diode are commonly employed and regarded as effective tools for specific procedures [4]. Among the use of a laser as a minimally invasive technique has many advantages, including its ability to be applied from a distance, increased visibility in the operating room, precision cutting, hemostasis, minimal cicatrization, superior infection control, excellent wound healing, decreased postoperative pain and swelling, and patient acceptance [5]. Diode lasers are gaining popularity in periodontal surgery because they are easily absorbed by pigments like melanin and hemoglobin, so low absorption by water and hydroxyapatite ensures their safety when employed near dental hard tissues [6].In dentistry, lasers have advanced to great heights, and as a supplementary method for soft tissue surgery, they have proven invaluable in oral surgery. The reason for this quick development is that lasers make it possible to perform soft tissue treatments quickly and effectively while maintaining good field visibility and hemostasis. In conjunction with scalpels, electrocautery, or high-frequency devices, lasers maximize patient comfort following surgery [7]. There are numerous uses for diode lasers in dentistry. It is a solid-state semiconductor laser that has potential applications in arsenic, gallium, and aluminum. It is possible to emit beams continuously or pulsed. When it comes to tissues that are pigmented with collagen, melanin, and hemoglobin, this laser absorbs lightest; in contrast, it absorbs less in dental hard tissues. Because of this, it can be used to surgically treat oral soft tissue lesions that are near dental structures without causing excessive bleeding [8]. Due to the characteristics of laser radiation, such as customizable energy and power densities and monochromatism, this technology also permits the use of particular therapeutic measures that have a variety of effects, such as quicker wound healing[9]. In this study, benign fibroma lesions of the mouth were excised using two different diode lasers. One was a blue laser operating at 450 nm, and the other was near-infrared, operating at 980 nm.

The current study aimed to evaluate the clinical scores (pain and oedema) in excision of oral fibroma lesions by two types of diode laser (blue laser 450 nm and near-infrared diode laser 980 nm).

2. Materials and methods

2.1. Age and sex

The mean age of examined sample was 27.93±14.44 year (16-45 year). The mean age of 450nm group was 40.6± 2.73-year-old (68.4%) of them female and (32.4%) male, while the mean age of 980nm group was 38.26±2.88 (57.8%) of them female and (42.1%) male, Figure (1 and 2).

2.2 Clinical Evaluation scores

1. Pain scale (Numeric rating scale)

Pain and discomfort were assessed using a rating scale. It is used to define pain intensity: no pain, mild pain, moderate pain and severe pain. The patients were given a questionnaire case sheet to fill out every day from the first day of surgery to the tenth day in order to document their level of pain and discomfort [10].

- 0= no pain
- 1-3= mild (nagging, annoying and interfering with activities of daily living ADLs).
- 4-6= moderate pain (interfering significantly with ADLs)
- 7-10= sever pain (disable unable to perform ADLs).

2. Oedema scale: determined as following [11]

- 0= No oedema.
- 1= very slight oedema (hardly visible).
- 2= slight oedema.
- 3= moderate oedema
- 4= sever oedema (extent swelling even beyond the application area).

2.2. Time of the irradiation and procedure of excision

The irradiation period for the 450nm operation was 2-3 minutes due to the non-contact mode and high absorption in hemoglobin. Tip cleaning was not necessary for the 450nm operation. However, the 980nm operation required 5-10 minutes. As a result of tip cleaning, the duration of the 980 nm may be prolonged to 15 to 20 minutes. However, the operational timeframe may vary depending on the size and location of lesion. The duration of follow-up varied depending on the clinical score. For instance, the follow-up period for the oedema score ranged from one to seven days, while for the pain score it ranged from one to ten days.

2.3. Statistical analysis

All data were tabulated and subjected to statistical analysis. Data analysis was performed using JMP 16 (Gary, USA). This analysis included descriptive and association tests for comparison between the two laser techniques. The student's t-test was used for measurable variables. The level of significance was set at $P \leq 0.05$.

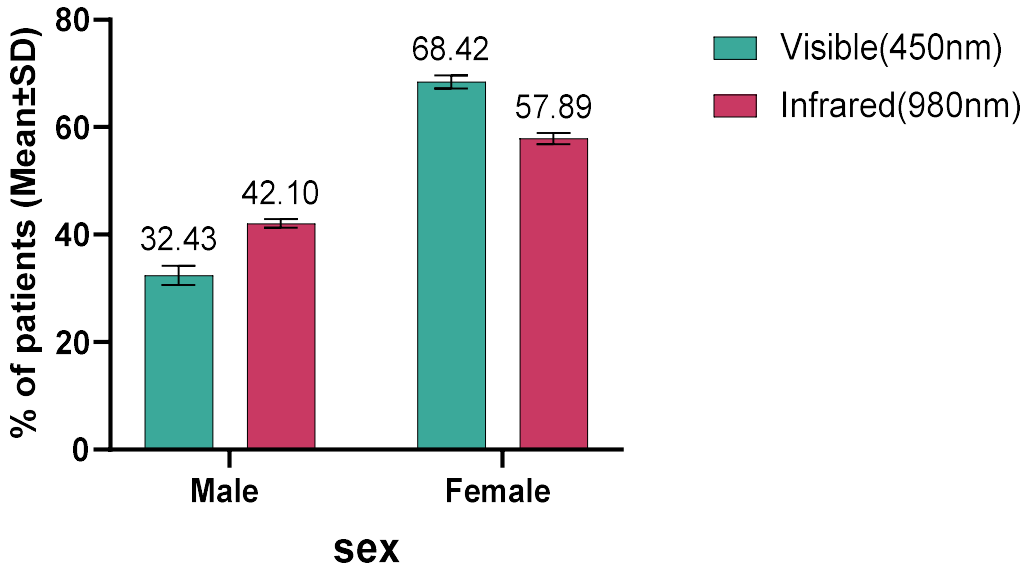

Fig. 1: Bar chart representation of mean value and standard deviation for Comparison between the study groups by gender, Blue-Laser and Infrared.

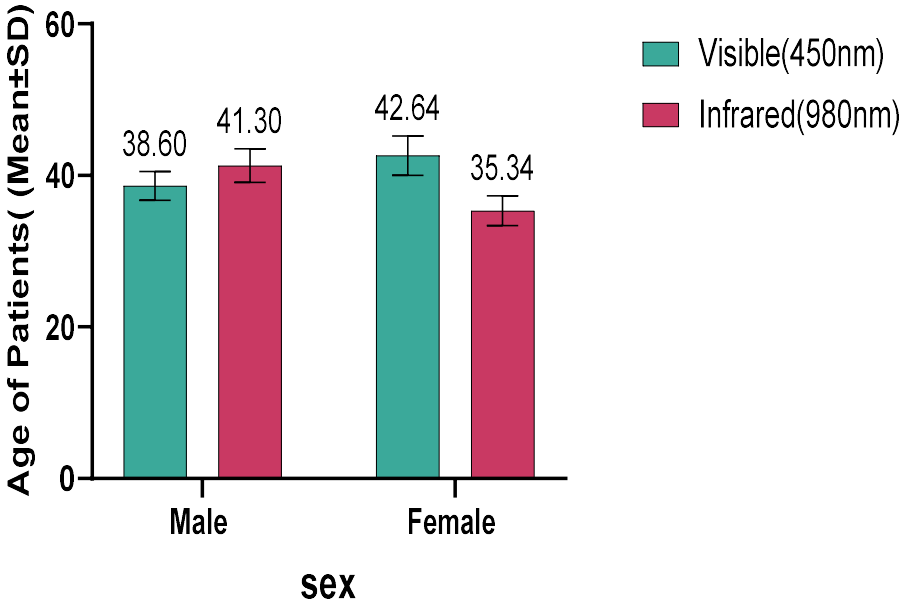

Fig. 2: Bar chart representation of mean value and standard deviation for the age of study groups.

3. Result

The findings of the research study, provides an analysis and interpretation of these findings, draws implications based on the results, and outlines potential avenues for further research. This study encompassed a cohort of 38 patients who underwent therapy for oral fibroma lesions.

3.1. Pain scores

The results of this study showed that there is a significant difference in pain levels between the two types of diode laser, where the pain scores differed significantly. 450nm treatments showed less pain (2.72±0.51) after one day of the laser surgery and 0 pain after one week compared to 980nm treatment where the pain score was (4.45±0.1) after one day of the laser surgery and (0.1±0.22) after one week, Table (1).

Table 1: Comparison between the study groups by means of pain score at three days, one week, two weeks, and four weeks after operation.

Post-operative pain	Study group		P value
	Visible(450nm) Mean±SD	Infrared(980nm) Mean±SD	
1st day	2.72±0.51	4.45±0.1	0.001
3rd day	0.92±0.51	2±0.3	0.003
One week	0	0.1±0.22	0.9918
Two weeks	0	0	-

3.2. Oedema

The findings of the study revealed a disparity in postoperative edema between the groups examined. As shown in Table (3), the comparison between 450nm and 980nm treatments reveals that the 450nm therapy significantly decreases swelling.

Table 3. Measurement of swelling at 2, 5, and 7 days postoperatively to draw comparisons between the study groups.

Swelling score								
Infrared (980nm)					**Blue laser 450nm**			
	None	**Slight**	**Moderate**	**Severe**	**None**	**Slight**	**Moderate**	**Severe**
2nd day	5(26.31)	5(47.73)	9(26.31)	0	17(89.4)	2(10.5)	0	0
5th day	14(73.6)	5(26.31)	0	0	19(100)	0	0	0
Seven days	19(100)	0	0	0	19(100)	0	0	0

Oedema scores: 0= none, 1= slight, 2= moderate and 3= server

3.4. Clinical cases

A. Case no: 1

The male patient, identified as KA and aged forty-five, presented at the clinic seeking assessment for a lesion located in the angle of the lower lip. The individual stated that the condition had persisted for a duration of one year. The fibroma lesion was confirmed through clinical diagnosis. A decision was made to do a session of laser-assisted surgery for the purpose of eliminating the lesion. The decision was made to utilize a blue diode laser with a wavelength of 450nm for this experimental procedure. The laser was operated at a power of 1.3W in pulsed wave mode, and an optical fiber with a diameter of 400µm was employed in a non-contact configuration, maintaining a distance of 1-2mm. The laser was moved at a speed of around 6mm/s, as depicted in Figure 2.

B. Case no: 2

The female patient, identified as AA and aged thirty-three, presented at the clinic seeking an examination of a lesion located in the mucosa of her cheek. The individual provided an account stating that the condition had persisted for a duration of two years. The fibroma lesion was confirmed through clinical diagnosis. The patient is experiencing pain and discomfort, necessitating the excision of the lesion. After careful consideration, it was determined that the most suitable approach would involve the utilization of an infrared diode laser (980nm) following a specific protocol. The laser will be operated at a power of 1.3W in pulse wave mode, utilizing an optical fiber with a diameter of 400µm. The laser will be applied in contact mode, as seen in Figure 3.

4. Discussion

Several fibroma oral lesions were collected for the current study. The diode laser (980 and 450nm) at 1.3W was used to successfully remove the analyzed lesions. Diode laser 980nm was applied in a contact mode, whereas 450nm was applied non-contactly (at a distance of 1-2 mm).

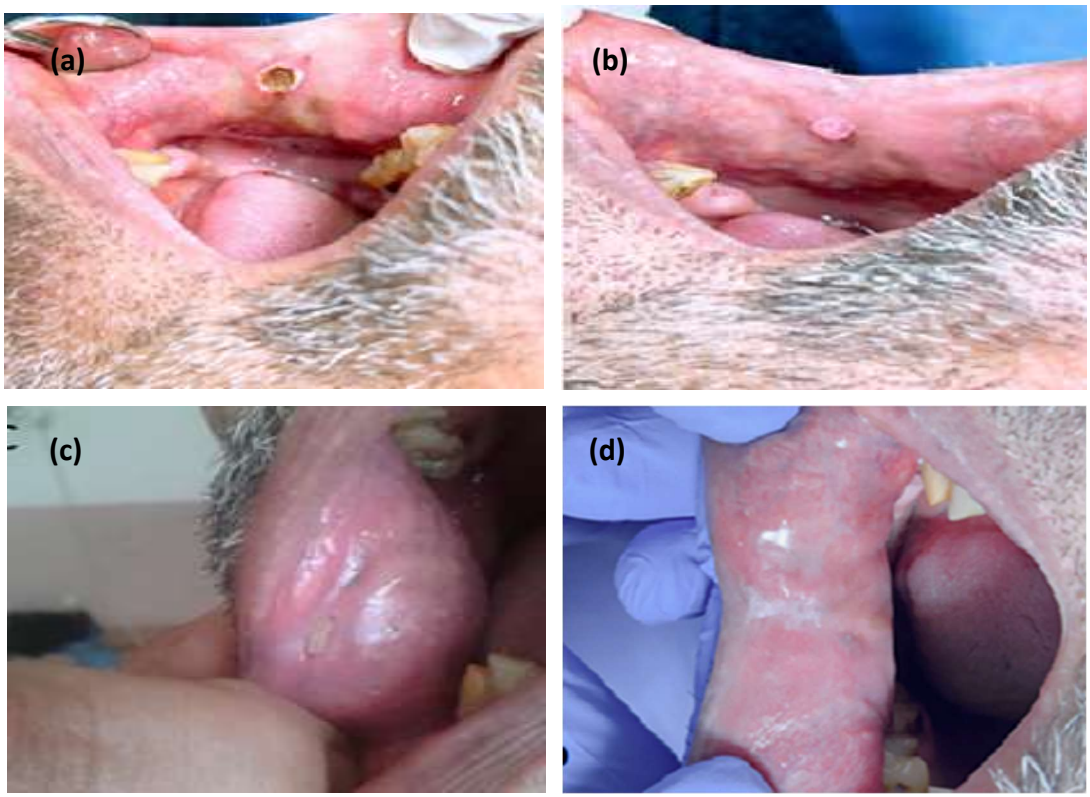

Fig. 4. Excision by diode laser 450nm. (A) Before treatment, (B) immediately after laser surgery, (C) One week after treatment and (D) Two weeks after treatment.

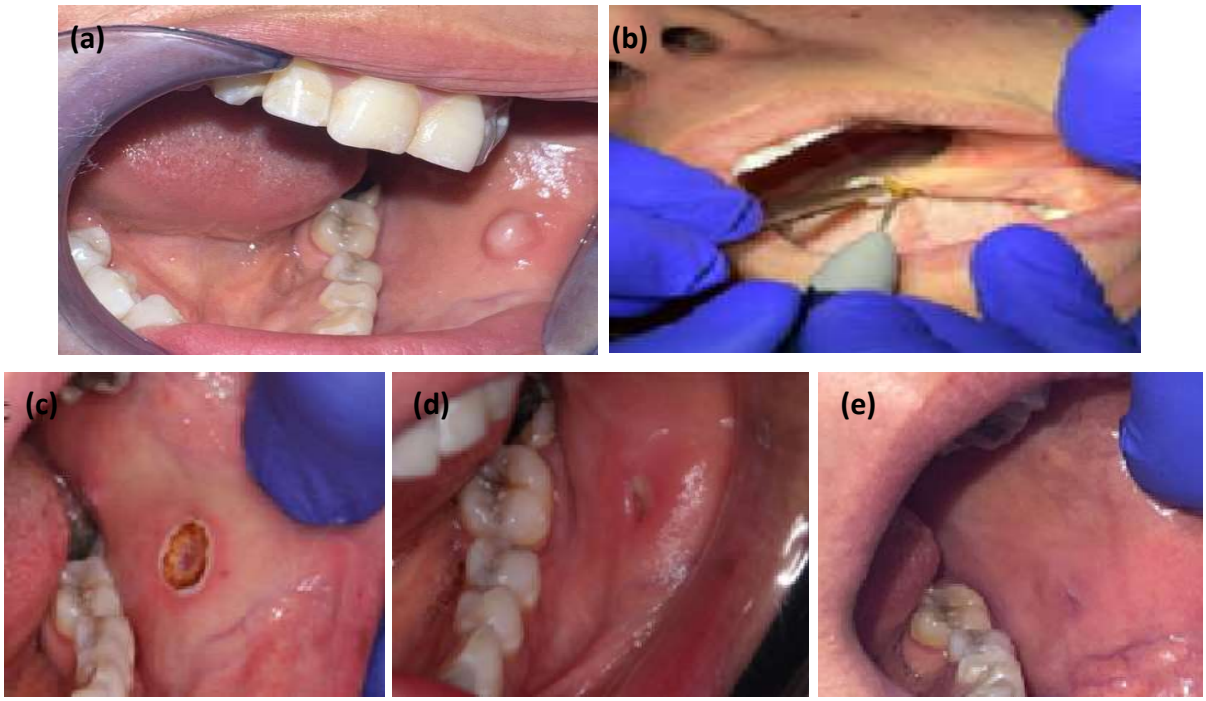

Fig.5: Excision by diode laser 980nm. (A)Before treatment, (B) During laser surgery, (C) Immediately after treatment, (D) One week after treatment, and (E) Three weeks after treatment.

Due to its portability, low cost, and high predilection for hemoglobin and dark pigments, the diode laser was employed to eliminate an oral benign lesion in the current experiment, reaping the many benefits of laser surgery. Patients favored laser surgery since it was a low-stress procedure for them during and after the procedure. Therefore, both patients and dental specialists can profit from diode laser because it is a minimally invasive treatment option.

Patients are administered local anesthetic, either in the form of topical application or injection, based on the specific nature of the lesion. This finding is similar with previous studies conducted by Azma et al and Gholizadeh et al which indicated that the necessity of local anesthesia injection is contingent upon the patient's pain threshold, as well as the size and location of the lesion [12, 13].

In the majority of cases, postoperative pain was alleviated as a result of the laser's capacity to inhibit nerve endings, hence mitigating postoperative discomfort. The observation indicated that the use of a 450nm treatment resulted in reduced post-operative discomfort, which subsequently resolved within a day following the surgical procedure. The pain experienced by patients undergoing diode laser surgery at a wavelength of 450nm was found to be lower compared to those undergoing surgery at a wavelength of 980nm. This difference in pain levels can be attributed to the fact that individuals undergoing the 450nm treatment had reduced instances of thermal necrosis[14]. The majority of patients necessitated modest postoperative analgesia. Previous research has indicated that variations in the diode laser's characteristics are contingent upon factors such as the wavelength and duration of its use. A separate investigation revealed that those who underwent laser treatment at a wavelength of 450nm experienced significantly reduced levels of pain and suffering following surgery, along with a higher level of overall satisfaction. The utilization of a diode laser operating at a wavelength of 450nm necessitates the implementation of a noncontact form of radiation delivery [14]. This particular mode of delivery has been seen to yield reduced levels of thermal necrosis. This observation is consistent with existing literature on the subject. The utilization of a diode laser with a wavelength of 450nm resulted in reduced intraoperative and postoperative hemorrhage and pain due to its robust cutting and coagulation capabilities.

It has been demonstrated that the laser can perform a hemostatic technique during surgery by occluding smaller diameter blood arteries and shutting lymphatic veins, hence minimizing postoperative complications including swelling and oedema. This study's findings corroborated those of Roy et al., who established that patients were contacted again after two weeks. In Addition, The blue laser has demonstrated additional benefits, such as a more pronounced bactericidal action through irradiation [15] result as Patients no longer reported any symptoms of pain associated with the lesion. The diode laser was found to have benefits in this investigation for both types of lasers. When it comes to benign lesion excision and reduced edema, however, laser diode 450nm triumphs over laser diode 980nm It has been reported that lasers can speed up the healing process and win over more patients. With laser surgery, there is less blood loss, faster sterilization, less bacteremia, and no need for sutures except for some lesions need suturing according to size of lesion and patients oral hyogen. He spoke of reduced pain and edema during and after the procedure, as well as lessened wound contraction and scarring [16]. This agrees with the study's findings that diode lasers, in general, speed wound healing, minimize bleeding, and alleviate pain. Although the 450-nanometer diode laser is displayed as the more practical option. When Gobbo et al. examined the efficacy of the blue group with the IR group, they discovered that the absence of any bleeding in the blue group was a major advantage compared to the IR group. Another study by Majeed and Aldelaimi when used 980nm to remove oral lesion showed that some of clinical score such as pain score and oedema took more than two weeks for the patient to heal completely [17] and this is with the consistence with our study where the diode laser 980nm almost showed the same result while blue laser need less than two weeks. The BLUE laser is widely regarded as the most comfortable medical device available; this is especially beneficial when dealing with sensitive patients like youngsters, the mentally ill, or those who are scared of needles [18]. One reason why the BLUE laser is associated with less discomfort after surgery is that it causes less heat damage to tissues. Because histological alterations are minimized, local inflammation can be reduced [19]. This is in line with the current study's findings, which indicated that the blue group experienced no bleeding, little discomfort, limited heat damage, less oedema, and a speedy recovery. Only lasers with an IR emission wavelength spectrum are considered for surgical use in the vast majority of published clinical works on oral surgery.

however, blue lasers have only lately been approved for medical usage. Since the blue laser's (450 nm) hemoglobin absorption is greater than that of the infrared laser's (980 nm), the 450 nm laser is recommended for larger lesions and deeper penetration. The blue laser works because its wavelength is absorbed not by water but by the chromophores in melanin and hemoglobin. This allows for the possibility of a number of improvements in the field of surgery, such as the elimination of blood loss and, in most circumstances, the necessity for sutures. Reduced number of procedures, no or minimal pain, high rates of functional and cosmetic success, minimal to no bleeding, and great visibility are all connected with this laser technology. Furthermore, a comparison between a 445nm semiconductor laser and a 970nm diode laser was performed by Braun et al when they determined that increased efficiency when cutting is to be expected. Clinically acceptable incision depths can be achieved with the non-contact use of a 445 nm laser without causing considerable denaturation of the soft tissues [20].

The benefits of using a 450 nm laser at very low power for oral surgery are confirmed by this investigation. It helps to control tissue bleeding, minimize the time of the intervention during surgery, and eliminate the need for anesthetic injections in most circumstances. From the patient's point of view, it allows us to lessen pain and avoid using sutures. During the follow-up, no signs of pain, discomfort, oedema, or infection arise, and no medication is required in more cases. There are no negative effects, and the recovery time is only one week. This corroborates the findings of Fornaini et al the 450-nm laser is safe and does not cause any tissue damage when used at an appropriate distance and for a brief duration. Lasers emitting at 450 nm had a far lower heating capability than those emitting at 980 nm [21]. In addition, 450 nm had a quieter working environment. The 450nm laser has the advantages of low noise during work, a thin coagulation layer, and efficient tissue vaporization. These characteristics suggest that the novel 450nm laser could be used as a therapeutic alternative in surgery. The cutting efficiency of a diode laser 445nm was found to be higher when compared to that of a diode laser 970nm and high-frequency surgery [20]. Furthermore, there are no signs of significant soft tissue injury when using the diode laser 445nm in non-contact mode, and incision depths are clinically acceptable. This observation agrees with the findings of this investigation. Blue laser light has a shorter wavelength and a higher absorption coefficient in the target chromophores hemoglobin and melanin, making it less scatter and penetrate tissue than near infrared laser systems. This shallow penetration allows for more accurate control of the laser's light and reduces the potential for accidents in deeper levels. Additionally, it is expected that the reduced thermal side effects will occur from the reduced absorption of laser energy in surrounding tissues due to dispersion. Soft tissues consist primarily of water, blood, color, lipids, and proteins. The red blood cells have a maximum absorption wavelength of approximately 450 nm. This leads to a high intake of energy, which can rapidly cause coagulation. Additionally, it results in efficient cutting of lesions with minimal lateral thermal effect, leading to reduced swelling and discomfort.

5. Conclusion

Diode laser removal of benign lesions has a low invasive approach and several therapeutic benefits, making it a viable therapy choice advantages include a shorter recovery time for the patient, less risk of infection, less postoperative pain, better management of bleeding, and higher patient satisfaction due to the absence of wound suturing in most circumstances. For surgical removal of an intraoral benign lesion, the diode laser (450-980 nm) can be utilized successfully with optimized parameters. The results of this study demonstrated that the 450-nanometer wavelength of the diode laser was superior to the 980nm wavelength in terms of performance.

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التقييم السريري لاستئصال الآفة الحميدة في الفم باستخدام الليزر بالطولين الموجيين 450 و 980 نانومتر

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الخلاصة: يستخدم الليزرذو الصمام الثنائي بأطوال موجية مختلفة لما له من فوائد كثيرة في جراحة اسئصال الافات الفموية الحميدة بسبب امتصاصة الجيد من قبل اصباغ الميلانين والهميغلوبين مع امتصاص ضعيف من قبل المياه والهيدروكسبيتات مما يجعله امنا للاسخدام حول الانسجة الصلبة والاسنان حيث يساعد على تقليل فترات شفاء المرضى والقدرة على تخثر الأنسجة عند الشقوق الجراحية وألم أقل و تطهير موضع الجروح ، وكل ذلك يقلل من الحاجة إلى الدواء ويزيد من راحة المريض خلال فترة التعافي كما أن له تأثير إيجابي على التئام الجروح. هذا ويعمل الليزردايود بكفاءه عالية ضمن طاقة اقل ونتيجة لذلك يمكن تقليل التأثيرات الجانبية غير المرغوب فيها إلى حد كبير. ان الهدف من هذه الدراسة هو تقيم كفاءة الليزر ذو الصمام الثنائي بطوليين موجيين (450 و980 نانومتر) وتحديد فعاليتهما ضمن النتائج السريرية للمريض والنتائج التحليليه المختبرية للعينات بعد استئصال الآفات الفمويه الحميدة . شملت هذه الدراسة ثمانية وثلاثين مريضاً تتراوح أعمارهم بين 16 و40 عاماً. تم اعداد الليزر لكلا الطولين الموجيين موضع الدراسة على وضع الموجة النبضية، وقطر حافة اللياف القطع على قياس 400 ميكرومتر و بطاقة 1.3 واط. بينت نتائج الدراسة الحالية ان الليزرفي الطول الموجي 450 نانومتر كان أكثر فعالية في الحصول على نتائج سريريه تتضمن اقل الم للمريض بعد القطع واقل تورم ضمن موقع استئصال الافه وبالنتيجه شفاء اسرع في أقل من أسبوعين.