Dental, Oral and Maxillofacial Research

Research Article ISSN: 2633-4291

The effects of conventional scalpel *versus* diode laser incision on postoperative morbidity after impacted third molar extractions

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Abstract

Objectives: This study aimed to evaluate the effects of conventional scalpel versus diode laser incisions on postoperative pain, edema, and trismus in impacted third molar surgery.

Materials and methods: The study included a total of 32 patients with vertically impacted wisdom teeth on the right and/or left side. In each patient, the mucosa was incised under local anesthesia: with a diode laser in one group, and a scalpel in the other. Subsequently, the soft tissue flap was repositioned, and the wisdom tooth was extracted. Incisions made with the laser diode were not sutured, and incisions made with scalpel were closed with simple primary sutures. We measured the distances between the tragus and the commissure, between the tragus and the menton, and between the lateral canthus of the eye and the gonial angle, and mouth opening immediately before the operation by using a ruler. Patients were invited for follow-up after 48 hours and 7 days after the operation. Any edema and trismus measurements were recorded. Pain was evaluated using VAS. **Results:** Mouth opening was significantly lower in the scalpel group compared to the laser group on postoperative day 2 ($p = 0.01$), but this difference was no longer statistically significant by postoperative day 7. Compared to scalpel incision, laser incision was associated with statistically lower pain scores and edema on postoperative days 2 and 7 ($p<0.05$).

Conclusion: In reference to our results, we conclude that using laser incisions in the surgery of fully impacted third molars positively affected postoperative complications of pain, edema and trismus.

Introduction

Mandibular third molars are frequently impacted due to their localization and being the last teeth to erupt. Problems associated with impacted third molars result in numerous prophylactic and therapeutic indications for extraction. Extraction of impacted third molars is one of the most common operations in oral and maxillofacial surgery practice [1]. However, this procedure is associated with prominent post-operative complications such as pain, edema, and trismus, which can result in discomfort for both the patient and the clinician. These complications can interfere with patients' activities of daily living, such as sleeping, eating, and chewing, and even hinder some patients from undergoing surgical procedures. Pain usually peaks 3 to 5 hours after surgery when local anesthesia wears off, and swelling peaks after 12 to 48 hours, affecting both facial appearance and social interactions. Trauma during surgery is considered to be the etiological factor behind the inflammatory process that is accompanied by postoperative complications. Although pain and swelling gradually dissolve within the first postoperative week, moderating these complications is prominent for both the surgeon and patients. Most surgeons try to reduce the post-operative complications of third molar surgery with analgesics, nonsteroidal anti-inflammatory drugs, or corticosteroids, but the side effects associated with these drugs are of concern [2].

Multiple novel methods have been developed to increase treatment success and patient comfort in oral and maxillofacial surgery, one of the most prominent being laser applications. Lasers have been successfully used in oral and maxillofacial surgery since the 1980s, and laser surgery has become increasingly popular with the development of smaller-sized and easy-to-use devices. Laser incisions offer numerous advantages compared to the traditional scalpel. Laser excision of soft tissue is significantly more precise than excision by scalpel. Moreover, laser causes coagulation, seals lymphatic vessels, and helps to keep the surgical site clear of bodily fluids. Lasers also sterilize the wound during ablation, resulting in minimal edema and eliminating the need for irritating sutures [3].

Diode laser is the most commonly used laser in oral and maxillofacial surgery due to being portable and relatively low cost. Due to low absorption by teeth, it is highly successful in the treatment of superficial lesions in the periodontal soft tissue [4]. Diode lasers can produce incisions with more precise and smoother margins compared to other laser systems [5].

This study aimed to evaluate the effects of conventional scalpel versus diode laser incisions on postoperative pain, edema, and trismus in fully impacted (Class 1, Level A, vertical) wisdom tooth surgery.

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Key words: *tooth, impacted; molar, third; laser; anesthesia, local; trismus*

Received: February 21, 2021; **Accepted:** March 03, 2021; **Published:** March 05, 2021

Patıents and methods

Study population

After the study was approved by the ethics committee (2018/GUDHKAEK decision no 18.11/3), we included 48 vertically impacted mandibular wisdom teeth of 32 voluntary patients aged 21-40 years. The inclusion criteria were being aged ≥18 years, having Class 1 Level A vertically impacted wisdom teeth according to Pell and Gregory's classification, and volunteering to participate. The exclusion criteria were being aged <18, breastfeeding and/or pregnancy, using any medications, drug allergies, smoking, and not volunteering to participate. Before the surgery, the procedures to be performed and possible complications were explained to the patients in detail, and consent was obtained both verbally and in writing. The positions of the impacted teeth were preoperatively evaluated with standard panoramic radiography.

Surgery techniques

Patients were randomly divided into 2 groups, and all impacted tooth extractions were performed by the same researcher in compliance with asepsis and antisepsis rules. Before tooth extraction, inferior alveolar nerve block and buccal anesthesia were achieved using Ultracain D-S 2 cc (40 mg articaine hydrochloride and 0.006 mg epinephrine hydrochloride per mL, Sanofi-Aventis, Istanbul, Turkey).

Laser incisions were made using a diode laser in excision mode at 2 W power in contact mode (Biolase Epic 10, 4 Cromwell Irvine, California, USA). After tooth extraction, laser incisions were not closed with sutures.

Scalpel incisions were made using a scalpel No. 15 to extract wisdom teeth and were closed with simple primary sutures.

Data collection

We recorded the duration of the operation for each patient. We evaluated postoperative facial edema using the distances between the lateral canthus of the eye and the gonial angle (A), between the tragus and the commissure (B), and between the tragus and the pogonion (C) measured before and 2 and 7 days after the operation, as described by Bello *et al*. [6]. Measurements were repeated three times for each axis and the average values were recorded. The differences between the mean measurements from before and 2 and 7 days after surgery were used to calculate percent change in edema, as described by Bello *et al*.[6]

Postoperative trismus was evaluated by measuring maximum mouth opening (distance between the lower and upper incisors) with a ruler before and 2 and 7 days after surgery. Measurement was repeated three times and the average value was recorded. The differences between the mean measurements from before and 2 and 7 days after surgery were used to calculate percent change in mouth opening (i.e., trismus), as described by Bello *et al*. [6].

Pain was evaluated using the visual analog scale (VAS) before and 2 and 7 days after surgery as reported by the patient (0 'no pain', 10 'unbearable pain'). The patients were prescribed amoxicillin + clavulanic acid 1000 mg b.i.d. for 5 days and chlorhexidine gluconate t.i.d. for 5 days for antibiotic prophylaxis, and paracetamol 500 mg t.i.d. for analgesia. Patients were instructed to ice the operated side(s) for the first 24 hours.

Statistical analysis

The obtained data were analyzed using IBM SPSS Statistics software package version 21. Due to the non-normal distribution of data, inter- and intra-group differences were analyzed using the Kruskal-Wallis H-test and the Wilcoxon test, respectively. Statistical significance was evaluated at $p<0.05$.

Results

The study included 48 vertically impacted mandibular wisdom teeth of 32 voluntary patients (16 unilateral and 16 bilateral extractions).

Gender distribution was homogeneous across the two groups. The two groups were not statistically different in terms of age ($p>0.05$). The duration of operation was statistically shorter in the scalpel group ($p<0.05$) (Table 1).

On postoperative day 2, mouth opening was significantly lower in the scalpel group compared to the laser group ($p = 0.01$), but this difference was no longer statistically significant by postoperative day 7.

The two groups were not statistically different in terms of the distance between the tragus and menton on postoperative days 2 and 7 ($p > 0.05$).

The two groups were not statistically different in terms of the distance between the tragus and labial commissure on postoperative days 2 and 7 ($p > 0.05$).

The distance between the lateral canthus and gonion was significantly lower in the laser group compared to the scalpel group on postoperative day 2 ($p < 0.05$), but this difference was no longer statistically significant by postoperative day 7.

Pain scores were significantly lower in the laser group on postoperative days 2 and 7 ($p = 0.01$) (Tables 2 and 3).

Discussion

Pain, edema, and trismus associated with impacted wisdom tooth surgery cause fear, stress and anxiety in the patient, thus negatively impacting physician and patient comfort, and healing. Hence, the primary goal is to minimize postoperative morbidity. Several studies have compared conventional and laser surgery, and also different types of lasers in various specialties of dentistry. Conventional scalpel has been used for many years due to its ease of access and use, but a surgical laser offers a number of advantages when used for the incision of soft

Table 1. Differences between groups in terms of age and duration of operation

		Group						Mann Whitney U Test		
		n	Mean	Median	Min	Max	SD	Mean Rank	z	p
Age	Scalpel	24	23.38	23	21	27	1.53	22	-1.265	0.206
	Laser	24	24.04	24	21	28	1.88	27		
	Overall	48	23.71	24	21	28	1.73			
Duration	Scalpel	24	12.5	12	11	16	1.35	12.69	-5.903	**0.001**
	Laser	24	17.29	17	16	20	1.27	36.31		
	Overall	48	14.9	16	11	20	2.75			

Table 2. Differences Between Groups in Terms of Postoperative Day 2 Measurements

		Group						Mann Whitney U Test		
		n	Mean	Median	Min	Max	SD	Mean Rank	z	p
Mouth opening, post-op day 2	**Scalpel**	24	34.13	34	27	46	4.73	14.29	-5.082	**0.001**
	Laser	24	41.04	40	38	51	3.09	34.71		
	Overall	48	37.58	39	27	51	5.27			
Tragus–menton, post-op day 2	**Scalpel**	24	159.62	160	142	175	8.64	27.92	-1.693	0.09
	Laser	24	155.42	156	139	168	7.72	21.08		
	Overall	48	157.52	157.5	139	175	8.38			
Tragus–labial commissure, post-op day 2	**Scalpel**	24	118.75	118	108	130	6.15	27.71	-1.592	0.111
	Laser	24	116.29	116	108	128	6.15	21.29		
	Overall	48	117.52	116.5	108	130	6.21			
Lateral canthus–gonion, post-op day 2	**Scalpel**	24	110.5	110	99	122	5.79	29.42	-2.44	**0.015**
	Laser	24	106.58	106	94	116	5.15	19.58		
	Overall	48	108.54	109	94	122	5.77			
Pain, post-op day 2	**Scalpel**	24	4.04	4	2	6	1.12	34.75	-5.199	**0.001**
	Laser	24	2	2	1	3	0.72	14.25		
	Overall	48	3.02	3	1	6	1.39			

Table 3. Differences Between Groups in Terms of Postoperative Day 7 Measurements

		Group						Mann Whitney U Test		
		n	Mean	Median	Min	Max	SD	Mean Rank	z	p
Mouth opening, post-op day 7	**Scalpel**	24	39.83	40.5	33	44	3.05	21.04	-1.728	0.084
	Laser	24	42.08	41	39	53	3.31	27.96		
	Overall	48	40.96	41	33	53	3.35			
Tragus–menton, post-op day 7	**Scalpel**	24	153.75	156	137	170	8.53	24.48	-0.01	0.992
	Laser	24	154.33	154.5	139	167	7.69	24.52		
	Overall	48	154.04	155	137	170	8.04			
Tragus–labial commissure, post-op day 7	**Scalpel**	24	114.83	114	108	126	5.17	23.48	-0.507	0.612
	Laser	24	115.71	115	106	126	6.04	25.52		
	Overall	48	115.27	114.5	106	126	5.58			
Lateral canthus–gonion, post-op day 7	**Scalpel**	24	106.21	107	94	115	5.18	25.96	-0.724	0.469
	Laser	24	105.5	105	93	115	5.1	23.04		
	Overall	48	105.85	106.5	93	115	5.09			
Pain, post-op day 7	**Scalpel**	24	1.67	2	0	3	0.76	33.08	-4.564	**0.001**
	Laser	24	0.58	1	0	1	0.5	15.92		
	Overall	48	1.13	1	0	3	0.84			

tissues surrounding or covering a fully impacted wisdom tooth [7]. These advantages include no bleeding in the operated area, resulting in better visualization, instant sterilization of tissues, reduced bacterial population, minimal scarring, reduced edema and pain, not requiring sutures, faster recovery, and increased patient acceptance [8].

The incidence of inferior alveolar nerve damage, the most serious complication associated with mandibular third molar surgery, was reported as 0.26-8.4%. Trauma during mandibular third molar surgery has been reported as the major etiological factor behind inferior alveolar nerve injury. Other etiological factors include local anesthetic injections, endodontic therapy, orthognathic surgery, and implant surgery [9]. The incidence of lingual nerve damage in impacted wisdom tooth surgery has been reported to be between 0.1-22% [10]. In our study, there were no cases of inferior alveolar nerve or lingual nerve damage. We believe that this is partly due to the fact that we did not raise a lingual flap during surgery and made controlled incisions.

In their study, Bello *et al*. [6] compared primary and secondary wound closure and reported less edema in the secondary closure group but did not find any differences in terms of trismus or pain. Maria *et al*. [11] reported smaller postoperative changes in the secondary wound closure group and more edema and hematoma in the primary wound closure group. In our study, we applied secondary wound closure in the laser group and primary wound closure in the scalpel group. We believe that the type of wound closure was effective in the formation and drainage of edema.

Some researchers argue that the surgeon's experience is associated with the severity of postoperative complications [12], while some researchers argue that the surgeon's experience is not correlated with postoperative complications 13]. Waseem *et al.* [14] reported that the incidence of postoperative trismus, dry socket, infection, and paresthesia was higher in impacted mandibular third molar surgery performed by inexperienced surgeons compared to experienced surgeons, but that increased experience was associated with increased postoperative bleeding. In our study, all operations and measurements were performed by a single physician using the same surgical methods to standardize physician-related factors, including experience, in the development of postoperative complications.

Postoperative complaints are the most prominent within the first 2 days after impacted wisdom tooth surgery. Pain is worst on the day

of surgery, and inflammation peaks after 48 hours [15]. Pain is an unpleasant sensation that can occur with or without tissue damage in a particular area of the body and may be associated with a person's past experiences. Çayan *et al*. [16] compared the efficacy of diode laser and scalpel surgery in the removal of inflammatory fibrous hyperplasia among a total of 22 patients. They compared perioperative bleeding and postoperative pain, wound healing, and bacterial density. They reported that bleeding was significantly lower on the diode laser-treated side and found a significant decrease in the total number of bacteria in the laser group after day 1; however, this finding was not statistically significant. They did not find a significant difference in subjective postoperative pain between the groups but noted that postoperative wound healing was significantly faster in the scalpel group. De Araújo *et al*. [17] performed laser frenectomy in a patient who required the excision of the frenulum due to a diastema between the upper central incisors. They used the laser in continuous mode set at 808 nm wavelength and 120 Joule energy intensity and reported excellent results for the soft tissue procedure. They argued that the wavelength was well absorbed by hemoglobin and other pigments, and that postoperative pain and analgesic use were reduced. Moreover, a study by Amaral *et al*. [18] also showed significant differences in operation time and analgesic use with diode laser surgery compared to traditional scalpel surgery. Similarly, we found that pain scores were lower in the laser group than in the scalpel group.

Studies by Pirnat [19] demonstrated that small blood and lymphatic vessels were sealed as a result of the heat produced by the diode laser, thus, the laser was able to make soft tissue incisions 2-6 mm deep and eliminated bleeding and edema. In their study on rats, D'Arcangelo *et al*. [20] found that the healing of the scalpel incision was equivalent to or better than that of the laser incision due to the thermal damage caused by the laser. They also advocated the clinical use of low-level diode laser as an alternative to scalpel incision and suture healing.

Gupta *et al*. [21] included 30 patients clinically and histopathologically diagnosed with oral submucous fibrosis to evaluate the effectiveness of laser fibrotomy. They performed the laser fibrotomy under local anesthesia using a 2-W diode laser (980 nm frequency) in contact mode with a fiber-optic cutting tip. They analyzed mouth opening, tongue protrusion, and cheek flexibility before treatment and after a follow-up period of 9 months. They reported a significant change in VAS scores and mouth opening and tongue protrusion measurements. They concluded that lasers are a potential alternative to surgical fibrotomy as they are minimally invasive, cause less hemorrhage, and are associated with faster healing, minimal surgical site scarring, and reduced loss-of-function. Waseem *et al*.[14] defined trismus as a postoperative interincisal distance smaller than 25 mm. That said, there are currently no universally accepted criteria to define trismus specified in the literature. Therefore, we defined trismus as a below-normal mouth-opening capacity. The development of trismus after surgery is an important parameter to assess loss of function. It can be measured by using a ruler, a compass, or a Boley gauge. In our study, we assessed trismus by measuring maximum mouth opening before and 2 and 7 days after the operation. Mouth opening was significantly lower in the scalpel group on postoperative day 2, but this difference was no longer statistically significant by postoperative day 7.

Jaeger F *et al*. [22] used diode laser, electrocautery, and conventional scalpel for circumvestibular incision in 30 orthognathic surgery patients to evaluate their efficacy and safety by analyzing incision velocity, duration of operation, bleeding, changes in postoperative functions, pain, edema, wound healing, and infection. They found that diode laser was associated with reduced bleeding compared to scalpel and electrocautery incisions. Moreover, diode laser was effective in making surgical incisions but required a longer operation compared to the other incision techniques. They reported that diode laser incisions were associated with reduced postoperative pain, its most prominent benefit. After measuring 5 distances between 7 reference points, they found that the groups were not significantly different in terms of edema and that all groups had significant edema on postoperative days 1 and 7. However, healing was significantly better in the scalpel group compared to diode laser and electrocautery at the 3-week mark. They concluded that diode laser was an effective and safe alternative to traditional devices for circumvestibular incisions for Le Fort I osteotomy. Passi *et al*. [23] compared the postoperative effects of Er:YAG laser (2.94 μm wavelength, .7 W pulse energy and burs for osteotomy in impacted wisdom tooth extractions by analyzing VAS scores and the distances between tragus–commissure and lateral canthus–gonion to evaluate pain and edema, respectively. The laser group was associated with lower pain scores and bleeding, although this finding was not statistically significant, and significantly reduced postoperative edema. On the other hand, laser osteotomy was associated with a longer duration of operation and delayed resolution of trismus. However, the two groups were not statistically different in terms of wound healing and complications. In our study, edema was statistically lower in the laser group.

Conclusion

We found that laser incisions were statistically associated with reduced trismus on postoperative day 2 and reduced edema and pain scores on postoperative days 2 and 7. In reference to our results, we conclude that using laser incisions in the surgery of fully impacted third molars positively affected postoperative complications of pain, edema, and trismus. Further studies are needed that include different types of lasers, a larger sample, and different surgical interventions.

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