Original Article

Evaluation of Patient Perceptions after Frenectomy Operations: A Comparison of Neodymium-Doped Yttrium Aluminum Garnet Laser and Conventional Techniques in the Same Patients

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Abstract

Background: The aim of the present study was to compare the level of postoperative discomfort between labial frenectomy done by neodymium-doped yttrium aluminum garnet (Nd: YAG) laser and the conventional technique and evaluate the differences in the levels of postoperative pain and functional complications such as eating and speaking between these two methods. **Materials and Methods:** Forty patients requiring labial frenectomy in both jaws were included in the study. One side of each patient was treated with laser, whereas the other side was treated with the conventional technique and all surgeries were performed by the same surgeon. Postoperative pain and functional complications were evaluated for each patient and recorded using a visual analog scale on the operation day and postoperative 1, 3, 7 and 10 days. **Results:** The results indicated that patients treated with the Nd: YAG laser had lower levels of postoperative pain and were more comfortable while chewing and speaking at the operation day and postoperative 1st day ($P < 0.05$). **Conclusion:** The results suggest that Nd: YAG laser application during oral soft-tissue surgery provides better patient perceptions and less postoperative pain compared to conventional surgery.

Keywords: *Conventional surgery, frenectomy, labial frenum, neodymium-doped yttrium aluminum garnet laser, visual analog scale*

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Introduction

Frenulum is a fibrous mucosal fold that anatomically connects the lips and cheeks to the alveolar mucosa and/or gingiva and the underlying periosteum, and usually contains connective tissue and muscle fibers. Its main function is to modulate the labial movement.[1] However, in some cases, the frenulum grows beyond their normal limits and is located very close to the marginal gingiva, which results in limitations in lip movements, deformities in teeth, diastemas, and speech problems. In addition to these problems, abnormal frenulum also increases plaque formation by preventing the patients from brushing their teeth properly, thus causing a negative impact in oral health.[2,3] The problems caused by frenula are mostly observed on the labial surface of both jaws and between the central incisors; and to a lower degree on the lingual surface of the mandible. All of these complications can be treated or prevented with the surgical excision of frenulum.[1]

Frenectomy is the surgical removal of the whole frenulum, including the area connected to the bones. This procedure aims to remove excess interdental tissue and reduce the tension on the marginal gingival tissue. In addition to the conventional method using a scalpel, it can also be performed using lasers that are utilized for oral surgery, which has been reported to cause less postoperative pain and edema and minimal damage to the tissue.[4,5] The conventional method requires postoperative

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sutures and induces postoperative pain, swelling and more bleeding, however, utilization of lasers can prevent these ailments.

Depending on their tissue interactions and characteristics such as wavelength and frequency, various types of lasers (neodymium-doped yttrium aluminum garnet [Nd: YAG], Diode, CO2, Er: YAG, etc.,) can be used for soft-tissue surgeries.[6] With a wavelength of 1.064 nm, Nd: YAG lasers have excellent hemostatic activity and cannot be easily absorbed by hard tissues such as cement and dentin. Because of these qualities, they are widely used in dentistry for gingivectomy, incisional and excisional biopsy, periodontal treatment, frenectomy and various other soft-tissue surgeries.[7-9] These features make the utilization of lasers more attractive than conventional surgeries.

Although several studies have previously shown that the use of Nd: YAG lasers for labial frenectomy is superior compared to the conventional techniques; the studies where both techniques are comparatively examined on the same individual is still not sufficient. The aim of the present study is to investigate the postoperative pain and postoperative functional satisfaction levels of patients after frenectomy when both Nd: YAG laser and the conventional technique are applied to the jaws of the same patient.

Materials and Methods

Study design

This study was designed as a split-mouth randomized comparative study to evaluate the clinical outcomes of frenectomy performed with conventional or Nd: YAG laser surgery. The present study protocol was reviewed and approved by the Local Ethics Committee of Adiyaman University in accordance with the Helsinki declaration with the decision number 2016/8-2. The participants were selected from patients who had been referred to the Faculty of Dentistry, Adiyaman University between January 2016 and September 2017. Informed consent was obtained from all individual participants included in the study. Medical and dental histories of each participant were recorded accordingly. Forty patients (male: female ratio of 20:20) with mucogingival problems (abnormal labial frenum in both maxillary and mandibular jaws) were included in the study. All of the patients were from South Eastern Anatolia region and had similar socioeconomic backgrounds.

Inclusion criteria were: Frenectomy indication for orthodontic treatment; speech problems; lack of prosthetic or periodontal treatment; systemically healthy and had good oral hygiene at the time of the surgery. Individuals being treated with anti-inflammatories, antibiotics, or analgesics; having only one labial frenulum that needed surgery; pregnant or lactating; or having any type of suspicious oral lesions were excluded from the study. Patients with both maxillary and mandibular labial frenula extending to the interdental papilla were included in the study, so that the two different techniques could be used on the same patient, allowing more objective evaluation of patient perceptions.

To determine the degree of preoperative discomfort, the patients were divided into two groups: Group 1 included 20 patients (ten maxillary or ten mandibular labial frenula were treated with conventional surgery initially, and 2 weeks later, the other frenulum was treated with Nd: YAG laser surgery); Group 2 also included 20 subjects (ten maxillary and ten mandibular labial frenula were treated with Nd: YAG laser surgery initially, and 2 weeks later the other frenulum was treated with conventional surgery). Surgical procedures were performed by a single examiner (M. C).

Scoring method

The patients were asked to rate their degree of pain and discomfort during chewing and speaking on a visual analog scale (VAS) on a 100 mm line with "stops" at each end. The line was horizontal. The far-left side of the scale, "0," meant 'no pain or discomfort during chewing, and no discomfort while speaking," while the far-right side of the scale, "100," meant "extreme pain and discomfort during chewing and speaking," The scale increased in multiples of ten. The patients were asked to mark their level of discomfort on the operation day and postoperative days 1, 3, 7, and 10. All assessments and data collection were performed by the examiner (B. E) who was unaware of which procedure was applied to the jaws.

Treatment procedures

For the conventional surgery, after application of local infiltration anesthesia with lidocaine (2%) combined with epinephrine 1:100,000, the frenulum was grasped with a straight hemostat inserted to the depth of the vestibule and the frenulum adjoining the upper and lower surfaces of the hemostat was excised with a no. 15 blade. After the triangular resected portion of the frenulum was removed with the hemostat, a horizontal incision was made to separate the fibers. At the end of the operation, the wound was closed with 4.0 silk sutures. The sutures were removed 1 week after the surgery [Figure 1a and b].

For the laser frenectomy, an Nd: YAG laser equipment (Deka Smarty A10, Calenzo, Italy, a free-running pulsed wave laser with a wavelength of 1064 nm) was used. The following settings were used:

100 mJ of energy, 40 Hz frequency, 4 W power, and 150 ls pulse duration, maintaining contact between the fiber (300 lm diameter, plain-ended, optical fiber), laser and oral mucosa. The tip of the laser was not initiated or activated with carbon, black ink, or articulating paper. The procedure was performed under local infiltration anesthesia with lidocaine (2%) combined with epinephrine 1:100,000. The frenulum was held by a hemostat, and the upper and lower portions of the frenulum were incised by applying laser energy via a fiberoptic probe. The laser was also used to remove any adhesions of the frenulum to the periosteum. No sutures were placed after laser surgery [Figure 1c and d]. The laser ray was carefully applied to the tissue, and extra care was taken to avoid local necrosis of the periosteum or any bone structure. Both conventional surgery and laser frenectomy were made by the same surgeon.

Patient preference and satisfaction

At the end of the study, all patients were asked which procedure they would choose if they were to have frenectomy. In addition, they were asked to choose at least one of the five following reasons for their answer:

1. Less pain
2. No sutures
3. No bleeding
4. More comfortable chewing
5. More comfortable speaking.

Statistics

The null hypothesis being tested was that there was no difference between patient perceptions after Nd: YAG laser and conventional surgical frenectomy. Nonparametric tests were used when evaluating among nonnormal distribution groups. Mann–Whitney U-test and Wilcoxon tests were applied to assess the VAS scores determined on the day of operation and after the operation in the pain, phonetic and function subgroups depending on the normality of the distribution. A Chi-square test was used to identify group distributions. Mean, standard deviation and percentage values of the data were calculated using SPSS 16.0 Windows (SPSS, Inc., Chicago, IL, USA) software and $P < 0.05$ was considered as statistically significant.

Results

A total of 40 patients, 20 female (22.1 ± 3.57) and 20 male (23.1 ± 3.44), were included in the study.

Figure 1: (a and b) Frenectomy with conventional technique (a) preop, (b) immediately after operation. (c and d) Frenectomy with neodymium-doped yttrium aluminum garnet laser (c) preop, (d) immediately after operation

Table 1: Demographic characteristics and postoperative scores of the patients included in the study

Demographic characteristics	*n* (%) (Mean±SD)				
Gender					
Female (age)	20 (50.00%) (22.10±3.57)				
Male (age)	20 (50.00%) (23.10±3.44)				
	Postoperative Scores				
Groups	**VAS scores (mean±SD)**				
	Operation day	**1st day**	**3rd day**	**7th day**	**10th day**
Conventional group					
Pain	27.25±16.94	13.00±14.18	3.25±7.30	0.50±2.21	0.00
Phonetic	20.50±13.39	12.25±12.50	2.50±6.30	0.75±2.67	0.00
Function	22.25±11.87	13.50±10.27	1.25±4.04	0.00	0.00
Laser group					
Pain	17±11.14	6.25±0.05	2.25±6.60	0.25±1.58	0.00
Phonetic	13±11.37	7.00±10.43	1.00±3.79	0.00	0.00
Function	16±11.50	11.25±8.83	0.50±2.21	0.00	0.00
	***P* value (conventional group vs. laser group)**				
Pain	0.0039	0.0027	0.4893	0.999	1.00
Phonetic	0.019	0.0028	0.1875	0.250	1.00
Function	0.0004	0.0931	0.5313	1.00	1.00

SD=Standard deviation; VAS=Visual analog scale

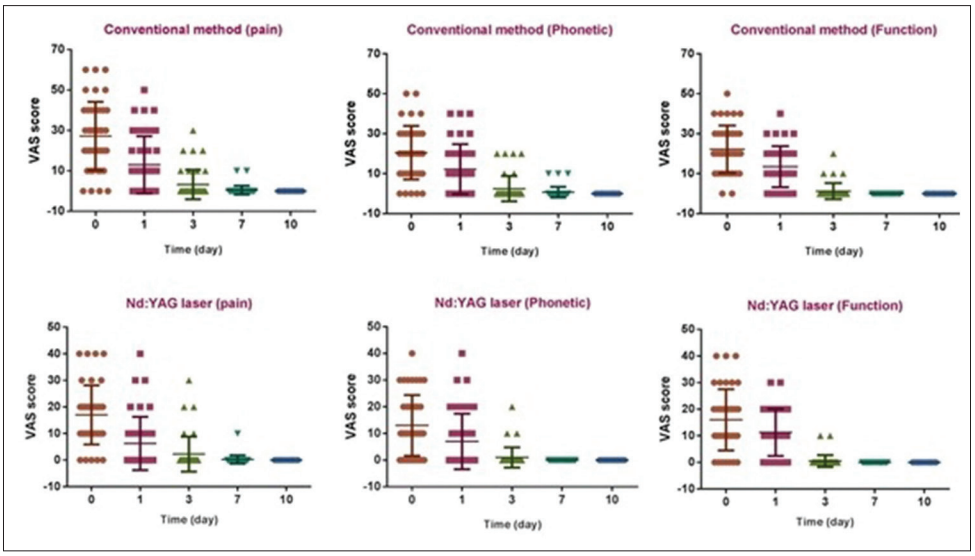

Figure 2: Comparison of visual analog scale scores in terms of pain, phonetic and functional recovery between conventional method and laser treatment

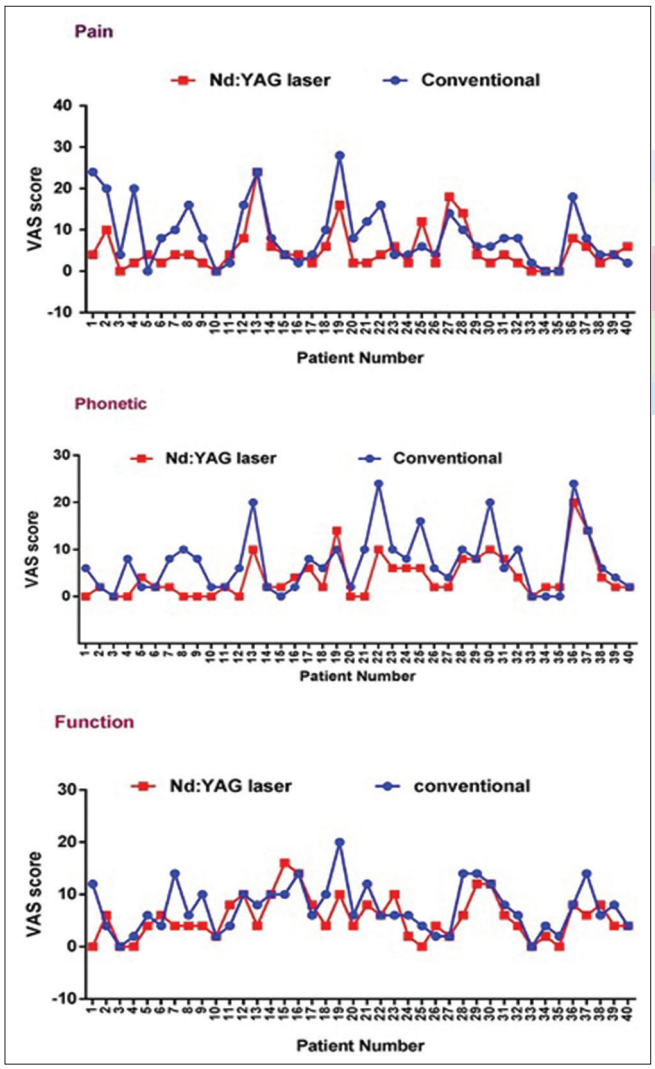

Figure 3: Evaluation of patient-based visual analog scale scores in neodymium-doped yttrium aluminum garnet laser and conventional methods. The visual analog scale scores of the group where neodymium-doped yttrium aluminum garnet laser was applied, were lower

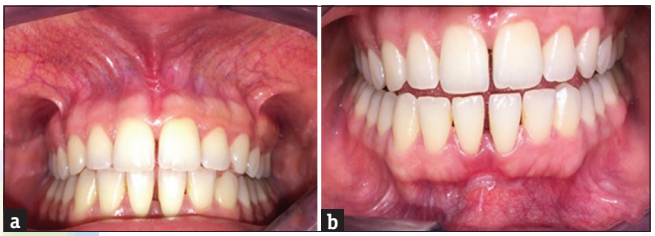

Figure 4: (a and b) Postoperative wound healing (a) conventional methods, (b) neodymium-doped yttrium aluminum garnet laser

On the day of operation, there were statistically significant differences between the laser treatment and conventional treatment groups in terms of all three scores (pain, phonetic, function). On the postoperative day 1, there was no significant difference in terms of function values while there were statistically significant differences between the groups in terms of pain and phonetic assessments. On days 3, 7, and 10, no significant difference was found between the two groups [Table 1 and Figure 2]. On the other hand, when the mean values f the pain, phonetic, and function values of the individuals were examined, it was observed that Nd: YAG laser application group had lower values in general [Figure 3].

After the operation, 77.5% of the patients (n = 31) preferred laser frenectomy, while 22.5% (n = 9) stated that conventional surgery was more preferable. The reasons for preferring the Nd: YAG laser method were mainly the lack of sutures (31.4%) and less pain (29.4%). In addition, no bleeding during the operation was among the primary reasons of preference compared to the other method [Table 2]. Strikingly, more comfortable chewing and more comfortable speech after the operation were reported in the conventional method compared to Nd: YAG laser. Postoperatively, no complications related to

Table 2: The reasons for preference between conventional method and laser after operation

	Preference					*P*
	Less pain (%)	Not sutures (%)	No bleeding (%)	More comfortable chewing (%)	More comfortable speaking (%)	
Total (*n*=40) 100%						
Laser (*n*=31) 77.5%	15 (29.40)	16 (31.40)	8 (15.70)	5 (9.80)	7 (13.70)	0.001
Conventional (*n*=9) 22.5%	4 (30.80)	0	0	6 (46.20)	3 (23.10)	

wound healing (bone exposure, infection, etc.) were seen in both groups [Figure 4].

Discussion

Lasers have been used as alternative or adjunctive treatments to traditional procedures in the treatment of periodontal diseases due to their many advantages such as hemostasis and sterilization.[7] The characteristics of the lasers depend on their wavelength. The wavelength of the laser affects both the design of the equipment and the possible clinical applications.[10] One of the most commonly used lasers in dentistry is the Nd: YAG laser.[11] It was proposed that Nd: YAG lasers could be used in oral soft-tissue surgery in 1989.[12] The application areas of Nd: YAG lasers in periodontology include labial and buccal frenectomies, tongue frenectomies, gingivectomies, gingivoplasties, periodontal pocket disinfection, and operculum operation.[13]

During routine dental treatment, pain control is not only important for the physical and psychological comfort of the patient but also for the effectiveness of the treatment. In addition, a painless, uncomplicated, and comfortable postoperative period enables the clinicians to predict the success of the treatment. On the other hand, there are very few studies comparing the postoperative effects of laser-based and conventional techniques commonly used in frenectomy operations.[14-17] Thus, the aim of this study was to compare the postoperative subjective effects of Nd: YAG laser and conventional techniques after frenectomy surgery by using a VAS.

In the present study, the conventional frenectomy procedure involved holding the frenulum with a hemostat, creating a large triangular wound area after the incision and using sutures to prevent excessive bleeding and combining the wound lips. In this technique, the main reason of postoperative pain, bleeding, and discomfort in patients is the sutures. In addition, since stitches may become lodged in the mucosa, patients may feel pain during the removal of stitches at 1 week after surgery. The Nd: YAG laser surgeries have significant advantages over the conventional technique, one of which is minimal or no bleeding after laser treatment. This reduces the risk of postoperative bleeding to a minimum. In addition, the laser beam ensures that the incised tissue is sterilized during the process. Thus, the risk of postoperative infection is reduced. Pain and swelling after surgery are minimized with laser treatment and fewer wound contractions occur during healing, which means that mucosal scar formation is less. Not using sutures not only reduces the duration of the surgery but also prevents damage to the neighboring healthy tissues. In conclusion, patients undergoing Nd: YAG laser surgery have lower risk of postoperative pain and higher chance of functional satisfaction compared to the conventional surgery.[9,15,18-23] In the present study, 77.5% of the patients preferred Nd: YAG laser, and stated the main reasons for this preference as less pain, no sutures and no bleeding after laser treatment.

White *et al*.[9] suggested that the Nd: YAG laser can be applied to intraoral soft tissues since it causes less bleeding which makes it more tolerable by patients compared to the conventional method. In the present study, the lack of postoperative bleeding with laser was the main reason of preference for most patients (especially female patients) compared to the conventional techniques. In the study by Cobb *et al*.[19] in which the effect of Nd: YAG laser on subgingival microflora was evaluated, Nd: YAG laser was shown to be effective against periodontopathogens such as *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Prevotella intermedia*. In addition, Moshonov *et al*.[18] have shown that Nd: YAG laser reduces the number of bacteria and thus the risk of infection in root canal treatment. In the present study, there were no signs of infection in the postoperative period for neither of the methods.

Although the tissue damage that can occur after laser application in soft tissues was reported to be minimal complications such as exposition of the bone might still occur after laser application.[17,20] In the present study, however, no soft or hard tissue necrosis was observed in any of the patients.

In one study, where the effect of gender was evaluated between Nd: YAG laser and conventional technique in frenectomy operations, Nd: YAG laser treatment was preferred by both women and men over the conventional technique in terms of postoperative pain, functional

recovery and phonetics.[16] Since the pain threshold differs among different individuals and this difference can affect the results of such a comparative study, here we aimed to evaluate both methods in the same patient. The results of the present study showed that VAS scores (pain, phonetics, and function) of the laser treatment on the day of operation and postoperative day 1 were statistically lower compared to those of the conventional method. Strikingly, all of the patients who preferred the conventional method were male patients.

While Medeiros Júnior *et al*.[17] found no statistically significant difference between laser treatment and conventional method in terms of postoperative pain and functional recovery in labial frenectomy, the present study showed that the laser application induces less pain, more comfortable phonetics, and functional recovery on the day of operation and on postoperative day 1. In a similar study by Kara less pain and less functional complication (while chewing and speaking) were observed on the day of operation (postoperative 3 h), 1st and 7th postoperative days after laser treatment.[15] Similarly, less pain and less functional and phonetic VAS scores were observed in the laser group in the present study on the day of operation and postoperative day 1. Unlike Kara's study, however, no significant difference was found between the groups at the 1-week evaluation of the present study.

Conclusion

The results presented in this study suggest that the Nd: YAG laser for oral soft-tissue surgery is more advantageous compared to the conventional technique in terms enhanced patient comfort and lower pain levels, especially in the early postoperative period.

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Conflicts of interest

There are no conflicts of interest.

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