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Assessment of the Patient Satisfaction from Adjunctive Laser Therapy during Orthodontic Treatment

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Abstract

***Background & Aims*:** Orthodontic patients may need different side treatments during their orthodontic treatment. These include a labial frenectomy to close the diastema, a corticotomy to speed up tooth displacement, or other treatments. In this study, the satisfaction of orthodontic patients in whom the treatment was performed with the help of laser radiation was evaluated by a standard questionnaire.

***Materials & Methods*:** In this study, 31 orthodontic patients who needed adjuvant treatment for various reasons and were referred to a specialized laser center in Urmia, Iran along 2020 were included in the study. Patients' files were reviewed and their demographic characteristics and type of treatment were recorded in a questionnaire. Patients' satisfaction with the treatment was assessed by calling them by phone and recorded by the researcher in a written questionnaire. Data were analyzed using SPSS 26.0 software and by statistical tests.

***Results*:**31 patients (25 females and 6 males) with a mean age of 23.71 ± 8.45 years participated in this study. The use of laser was collectively good but in accelerating the process of tooth displacement was the least and the use of laser in gingivectomy surgery is the most satisfactory forthe patients ($p = 0.002$). The type of laser had no effect on patient satisfaction ($p = 0.429$). The type of treatment and the type of laser had no effect onthe patients' stress during orthodontic treatment ($p > 0.05$). With increasing the number of treatment sessions,the patients' sedation levels increased significantly ($p = 0.009$). The type of treatment, type of laser, and number of treatment sessions had no effect onthe patients' pain ($p > 0.05$).

***Conclusion*:**According to the findings of this study and due to the high satisfaction rate of the patients from gingivectomy and frenectomy treatment by laser adjunctive treatment, laser may be used more in the future in the treatment of these patients with.

***Keywords*:** Laser Therapy, Orthodontic Treatments, Patient Satisfaction

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Introduction

Orthodontic treatments benefit from teeth displacement to achieve the desired beauty and function. This displacement causes force and subsequent process of destruction and reconstruction of periodontal tissue, especially in the alveolar bone (1). One of the most important problems and obstacles in achieving these therapeutic goals is the long-term orthodontic treatment, which in addition to the erosive nature of long-term treatment, also causes root resorption, gingivitis and tooth decay (2).

Laser irradiation is one of the emerging methods to accelerate the process of tooth displacement, which recent clinical trial studies had compared it to the other methods and saw its advantages such as non-invasiveness, ease of use, cheapness, and lack of need to additional equipment (3-6). On the other hand, the use of laser is widely used in dental treatments (7).

Lasers, like light, produce energy through the wave behavior of a particle. The energy produced cumulatively affects the target tissue (8). The energy produced by the laser causes frontal bone resorption and compression of the periodontal ligament without completely blockage of the blood vessels. Reduction of local blood supply to the area by stimulating the signals causes the formation of pre-osteoclasts, bone destruction, and subsequent tooth displacement (9).

Apart from the applications of lasers in accelerating the process of tooth displacement in orthodontics, lasers are also used in soft tissue surgeries such as labial frenectomy, gingivectomy, hypercholectomy, fibrotomy, and exposure of teeth. (10). Also,the patients who are treated with fixed orthodontic appliances usually experience reactive gingival hyperplasia at the site of contact due to the local inflammatory response and lack of hygiene, which is usually treated with gingivectomy as a treatment for this abnormality. Due to the disadvantages of using conventional surgical methods and using surgical razors, laser has commonly replaced them in surgery (11, 12).

Another application of the laser surgery in exposure is for treatment of fully occluded or semi-occluded tooth crown (laser hypercholectomy). In this case, it is used to attach brackets to occluded or semi-occluded tooth crown. Labial and lingual ferenctomy is also widely used to treat congenital and acquired abnormalities that interfere with orthodontic treatment (13). Fibrotomy is also one of the most widely used laser surgical treatments used to prevent relapse of rotated teeth (14).

Other applications of lasers in orthodontic include treatment of ceramic orthodontic brackets (15, 16) and enamel etching (17), and preventing white spots (18).

One of the factors in evaluating the successive outcome of treatment plans is their impact onthe patients' quality of life. In this study, we measured the effect of laser therapy on factors of quality of life ofthese patients like their ability to perform daily activities such as eating, speaking, and their self-confidence (19).

A study conducted by Kumar et al. reported promising results towardthe patients’ satisfaction in using laser in oral surgeries (20). The similar results were also reported in periodontal treatments (21). The aim of this study was to evaluate the role of lasers as adjuvant therapeutic tool in orthodontic treatments.

Materials & Methods

In this cross-sectional study, the patients who need orthodontic treatment referred to a specialized laser clinic in 2020 were included. After filing the questionnaire and obtaining written consent from the patients and fully explaining the treatment process, side treatment was performed for them. This side treatment was one of the following five processes according to the diagnosis of the orthodontist and laser specialist:

1- Buccal and labial ferenoctomy, which was performed to close the diastema and prevent gum problems during orthodontic treatment (Figure 1).

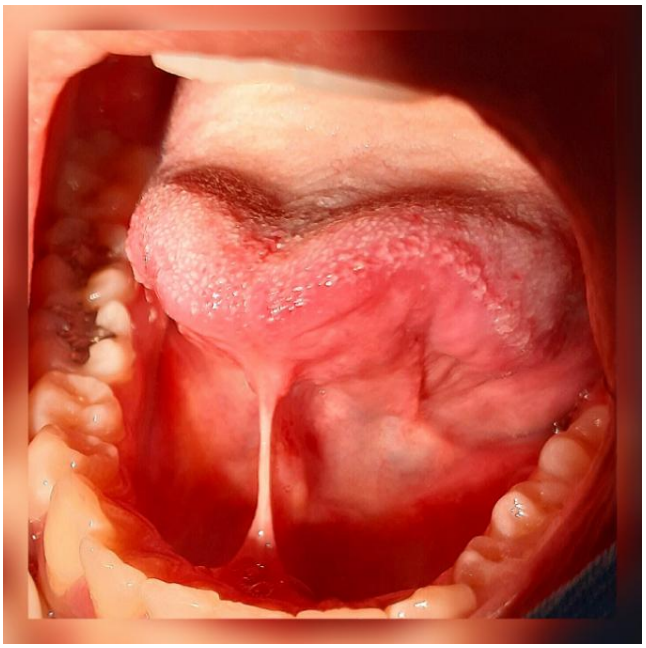

Fig. 1. Lingual ferenctomy

2- Lingual frenctomy, which was performed to improve speech and prevent gingival and lingual problems (Figure 2).

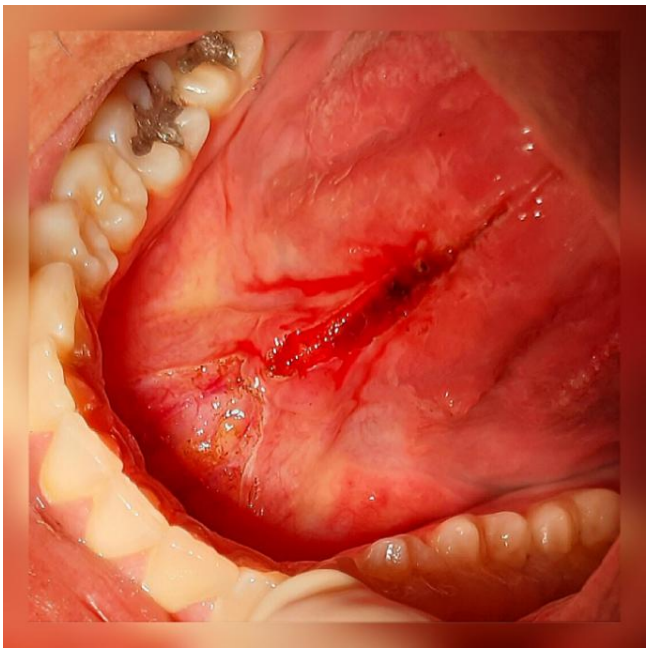

Fig. 2. Labial and buccal ferenectomy

3- Buccal gingivectomy, which was performed in one of the patients who had gingivitis and gingival hyperplasia due to orthodontic appliances and poor hygiene (Figure 3).

Fig. 3. Using laser in gingivectomy

4 - In the patients whom orthodontic movements are very slow, low-power lasers were used a few months after the application of force and with the diagnosis of orthodontist in accelerating orthodontic movements. These treatments varied from one to several sessions, depending on the case (Figure 4).

Fig. 4. Using laser in teeth displacement acceleration

5 - Palatal Gingivectomy which was performed to improve the treatment of retinal fixation and prevention of gingivitis or gingivitis in cases with gingival hyperplasia.

Patient satisfaction assessment form was designed from valid articles with the help of orthodontics and laser professors, and was filled out forthe patients who had undergone laser treatment. In this way, the patients' files were extracted from the archives of the specialized center and the patients were contacted by phone and the questions were answered.

This questionnaire contained 14 questions. The method of scoring the questions was numerically from zero to 5. The scoring value was very low, low, medium, high, and very high, respectively. The patients' quality of life was determined based on the questionnaire.

Due to the quality of all data collected in this study, coding has been used for numerical conversion. The minimum value (1) is for the very low option and the maximum value (5) is for the very high option. Specific numbers in this study are considered as code, and are identified as nominal variables. Considering that some variables had more than one question in the questionnaire (13 questions for 4 variables), we find it necessary to form a questionnaire structure.

Statistical analysis was performed using SPSS 26.0 software. Descriptive findings were reported as fashion, median, mean, and standard deviation (SD). Kruskal-Wallis and Mann-Whitney tests were used to evaluate the relationship between the patients' satisfaction with the evaluated parameters. The level of statistical significance between the studied variables was considered as 0.05.

The study protocol isconfirmed by Ethical committee of Urmia University of Medical Sciences.

Results

31 patients answered completely to the questions (6 males and 25 females). The mean age of the participants was 22.71 ± 8.45 years.

According to Kolmogorov-Smirnov normality test, all the mentioned variables has not normally distributed ($p< 0.001$). So non-parametric tests were used to analyze study hypotheses.

The results of the patient’s satisfaction, stress, and pain according to the type of treatment were illustrated in Table 1.

Table 1. Patients satisfaction, stress, and pain according to the type of treatment

Parameter	Gingivectomy	Labial Frenectomy	TDAa	GF b	Lingual Frenectomy	P-value*
Satisfaction	75.23± 2.73	69 ± 3.463	49.14 ± 5.146	71.25 ± 20.52	67.29 ± 5.348	0.002*
Stress	87.29 ±11.729	---	91.43 ± 3.723	----	86.67 ± 11.567	0.769
Pain	29.52 ± 10.452	21.67 ± 2.887	26.43 ± 9.449	----	------	0.453

[a]: Teeth Displacement Acceleration.[b]: Gingivesctomy + Frenectomy *Kruskal Wallis.

The results of the table 1. suggested thatthe patients’ satisfaction through laser irritation in gingivecotmy is significantly more than other treatment plans. There was no significant difference inthe patients’ stress and pain (Pvalues were more than 0.05).

The patients’ satisfaction, stress, and pain according to the type of used laser is illustrated in Table 2.

Table 2. The patients' satisfaction, stress, and pain according to the type of used laser

Parameter	Diode	CO2	P-value*
Satisfaction	64.79 α 10.435	69.76 ± 10.175	0.429
Stress	89.71 ± 8.062	82.86 ± 15.71	0.323
Pain	29.38 ± 10.855	23.57 ± 2.865	0.167

*Kruskal Wallis

According to the results, there was no significant difference inthe patients' satisfaction, stress, and pain according to the type of used laser treatment (pvalues were more than 0.05).

The patients' satisfaction, stress, and pain according to the number of treatment sessions is illustrated in Table 3.

Table 3. The patients' satisfaction and stress according to number of sessions.

Parameter	1	2	3	4	P-value*
Satisfaction	68.17 ± 11.02	69.11 ± 7.27	44 ± 4.223	53.25 ± 2.121	0.001 *
Stress	93 ± 12.62	90.67 ± 8.46	90 ± 14.42	87	0.009*
Pain	27.94 ± 10.009	30 ± 11.99	30 ± 14.143	22.5 ± 3.456	0.85

*Kruskal Wallis

According to the findings illustrated in Table 3, there was a significant increase in the patients' satisfaction and reduction in stress following repeated treatment sessions ($p < 0.05$). However, there was no difference inthe patients' pain in different treatment sessions ($p = 0.85$).

Also there was no reported difference inthe patients' quality of life according to the type of treatment, type of laser, and number of treatment sessions (pvalues were more than 0.05).

Also, 51.6% ofthe patients reported treatments' results as their expectations. In 90.3% of the patients, post-treatment complications were rare. 58.1% ofthe patients have very good safety sensation during treatment. Eventually 96.3% ofthe patients would like to suggest their friends and families to use laser.

Discussion

This study was one of the cross-sectional studies performed to evaluate the patients' satisfaction with laser adjuvant treatments in orthodontic treatments based on the parameters of type of treatment, number of treatment sessions, and type of laser used.

About 80% of the participants in this study were women. In the study of Ren et al., 81% of the participants were women (22). Probable reason of this is that women are more aware of modern dental treatments than men and care more about their appearance and beauty than men (23, 24). In this study, diode laser was used for treatment in 75% ofthe patients. Diode lasers are well absorbed into pigmented tissue and are therefore a good candidate for soft tissue surgery. They are also much safer because of the lower risk of damage to the underlying hard tissue (25). Diode lasers are especially useful in surgical treatments. However, as the treatments were performed at different wavelengths and output powers, it impossible to evaluate the role of these two parameters in the patient satisfaction (23).

In this study, the patients' satisfaction with laser gingivectomy treatment was higher than ferenectomy and tooth displacement treatments. Also, there was no significant difference between two lasers inthe

patients' satisfaction. The reason for the high satisfaction ofthe patients in laser adjuvant treatment in gingivectomy can be related to the more tangible results of treatment immediately after treatment (14). The reason for less satisfaction ofthe patients in ferenctomy compared to gingivectomy was probably lack of immediate treatment results in treatment with ferenectomy compared to gingivectomy (20-22). This shows the success of diode lasers in orthodontic surgeries.

In this study, the patients' satisfaction with diode lasers was not statistically different from carbon dioxide lasers. The patients undergoing laser treatment had less pain and more relaxation; however increasing number of the sessions in this method and the length of treatment decreases their satisfaction level. A study done by Li et al. in 2020, which examined the patients' satisfaction with 820 nm diode laser treatment in the treatment of facial pimples, showed that after 12 weeks,the patients' satisfaction was increased satisfactory (25), which is consistent with the findings of the present study.

In this study, the patients' satisfaction decreased with increasing the number of treatment sessions. In a study by Jowkar et al., which assessed the patients' satisfaction with alexandrite laser hair removal, the number of treatment sessions had no effect on patient satisfaction (26). In the study of Preston et al., although similar findings were reported in some circumstances (27), but in the case of number of treatment sessions do not correspond to the findings of our study. The reason for the discrepancy can be attributed to the difference in the type of laser as well as the difference in the participants' satisfaction measurement tool.

In a study conducted by Tahmasebi et al. on 193 patients, the main reason for dissatisfaction with orthodontic treatment in the patients was the long duration and the large number of treatment sessions (28). In this study, no relationship was recorded between the type of treatment, type of laser, and the number of treatment sessions with the quality of life of the patients. The study by Shakespeare et al. showed that the use of pulse dye laser to remove vascular lesions after 8 sessions and after a period of 6 months had improved the mental health of the patients and ultimately their quality of life (29), which is not consistent with the findings of the present study. In this study, the use of laser had no effect on the function ofthe patients, which was listed as one of the factors determining the quality of life of the patients in the present study. Li et al. in a study done in 2020 assessed the quality of life of the patients treated for acne skin removal using 420 nm diode lasers and dermatology life quality index questionnaire. Their results showed that the quality of life 12 weeks after treatment increased significantly compared to the control group (25). In this respect, it is consistent with the findings of the present study. In this study, the patients had the least complications and laser treatments did not impair the quality of the patients and did not reduce the patients' function, but improved their quality of life.

In this study, 96% of laser treatment participants were willing to recommend laser treatment to their friends and other patients. The study by Ren et al. reported this as 60.7% (22) and Shakespeare et al. as 90% (29), which is consistent with the findings of this study.

One of the limitations of this study was that it is retrospective, which needs more study to follow-up the patients in longer periods, as well as other studies which included their age and gender as variables. Also in this study, due to the low number of the patients undergoing teeth displacement, it was not possible to compare the efficiency of the laser types and the number of treatment sessions by the type of treatment. Future studies in the form of prospective studies are needed to examine the level of patient satisfaction with laser treatments by demographic variables such as age and gender.

Conclusion

Based on the findings of the present study and due to the high satisfaction ofthe patients with laser ferenectomy and gingival resection, it is suggested that more laser therapies were used as adjunct treatments in ferencetomy and gingevectomy in the future. Also due

to the role of the number of treatment sessions and the length of the treatment process caused by late referrals as one the factors reducing the patients' satisfaction, an accelerated teeth displacement process is recommended. These treatments should be performed in time by timely referral of the patients.

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Ethical statement

The study protocol is confirmed by Ethical committee of Urmia University of Medical Sciences.

Conflict of interest

None declared.

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