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Labial Frenectomy Performed with Conventional Surgery and Diode Laser: A Comparative Study.

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ABSTRACT

Low (coronary) insertion of the maxillary labial frenum was often associated with gingival recession, loss of the interdentally papilla, difficulties in maintaining oral hygiene, interfering with the stability and retention of the upper mobile prosthesis, diastema mediana between the maxillary central incisors and can be removed by a variety of surgical techniques. The aim of this study is to make a comparison between the –pre>-during>-and postoperative parameters of frenectomy proceeded with conventional surgery or diode laser. 40 patients have been involved in this study. They were divided into two experimental groups: Examined group 1(EG1) included 20 patients who were treated with conventional surgery and Examined group 2(EG2) from 20 patients were treated with diode laser. The frenectomy treated with laser were not followed with bleeding except for three patients where it was barely noticeable and no need for suturing. The average score of postoperative pain in patients in EG1 was 3.0 ± 1,5, and in patients in EG2 it was smaller (1.3 ± 1.3), the difference between them is statistically significant for $p<0.05$ The duration of the intervention and the average value of postoperative discomfort was significantly shorter/ smaller in cases treated with laser. $p<0,05$ A slower healing of the operative wound was registered in patients treated with laser. Labial frenectomy done with diode laser eliminates bleeding and suturing during intervention, significantly shortens the time of the intervention, provides less post-operative pain and discomfort whereas surgical frenectomy results with a faster healing of operative wound.

Keywords: conventional surgery, diode laser, frenectomy

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INTRODUCTION

Papillary and papillary-penetrating frenulum are considered pathological issue in dental clinical practice, because of association with inadequate width of the attached gingiva and shallow vestibule, which may lead to loss of the interdental papilla or recession of the gingival margin.[1-5]

Hypertrophic maxillary labial frenulum is to be involved in the etiology of median diastema between the maxillary central incisors or inhibits its closure during the orthodontic treatment.[6-8]Abnormal labial frenulum can limit movements of the upper lip, and in the cases of high smile line it also affects facial aesthetic. It also has adverse effect to the stability and retention of mobile prosthesis.[9]Considering the great clinical importance of a thick, fibrous and low inserted maxillary labial frenulum, the need of its appropriate adjustment is inevitably imposed.[10-13] Among all techniques in use today as more effective are suggested: Conventional (classical) frenulectomy introduced from Archer[14] and Kruger[15], Miller technique[16] Technique of Z-frenoplastic[17], V-Y frenoplastic etc.[18] Besides using routine surgical scalpel technique, the frenulectomy can be performed by electro surgery or use of lasers: diode lasers, ND: YAG laser, Er: YAG laser, CO2 laser etc.[19-24] Taking into consideration more common application of the lasers in oral soft tissue surgery as well, we inspired the main goal of this study-to make a comparison between preoperative, trans operative and postoperative parameters from the frenulectomy procedure performed by conventional surgery and with diode laser. Following individual goals were further defined: to measure surgical time required to perform the intervention; to assess bleeding during the intervention, or whether and how it is represented in the different treatment options; to evaluate subjective feelings of the patient (detected by several parameters: the fear before the intervention, patient's pain after the intervention, need for taking analgesics, and postoperative discomfort associated with orofacial functions like speech and mastication.

MATERIAL AND METHOD

For the realization of our goal, 36 patients which attended theUniversity Dental Clinical Center in Skopje, were included. After history was taken and clinical examination was done, diagnosis was low (coronary) insertion of maxillary labial frenulum and the need from frenulectomy was determined. Patients were informed about the necessity for the intervention and were offered to choose from the two possible methods of treatment, and after their decision and approval they signed written consent, than they were grouped in to one of the two experimental groups. First group included 18 patients who were treated at the Clinic for Periodontology and Oral pathology, using conventional surgical frenulectomy (EG1-experimental group 1) and second group of 18 patients treated at the Clinic for Pediatric and Preventive Dentistry using a diode laser (EG2-experimental group 2).

Inclusion criteria were: complete eruption of the upper permanent incisors and the existence of indication for surgical removal of maxillary labial frenulum from orthodontic, prosthetic, periodontal reasons or speech difficulties. Exclusion criteria were patients with: severe chronic systemic diseases, disorders or conditions accompanied with immunodeficiency, receiving immunosuppressive therapy. Regardless the indication, patients who are suffering from autoimmune diseases, smokers, and patients who received antibiotics, analgesics or anti-inflammatory agents before the intervention, and patients with oral lesions in the region of interest were not included as well.All patients data were recorded in a specially designed patient formulary (see Appendix 2), which included socio-demographic profile of the patient, indication for the frenulectomy, location, size and type of frenulum, level of preoperative anxiety, as well as data about the duration of the intervention, and data about the clinical healing of the wound, subjective discomfort of the patient, and if any, postoperative complications. Maxillary labial frenulum were classified by the classification according to Placek at al. [10] in four types of labial frenulum, depending on where the insertion of frenulum is.Our study included only cases with type of frenulum: 3 and 4. All frenulum were measured with a special measurer, caliper - gauge (vernier), their length from labial to gingival / papilla insertion and their width(thickness).

Prior to the intervention levelof preoperative fear was noted with numerical rating scale (Numeric Rating Scale NRS-11) [25]graded with values from 0 to 10, divided into 4 levels according the result: lack of fear (value 0), easily expressed fear (1-3), moderate (4-6) and severe and uncontrolled fear (7-10).

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During the surgery, surgical time was noted, measured from the moment of starting the incision until the end of the intervention; how much anesthetic is given to perform painless procedure; bleeding was classified empirically as absent (no bleeding), scarce (bleeding spots), moderate (moderate) or intensive (bleeding flow). On the third day, postoperative pain and discomfort were noted associated with oral functions that were assessed using the same numerical scale (NRS-11) [25], graded with a value between 0 (no pain or functional difficulty) to 10 (unbearable pain, or seriously compromised oral function), divided into 4 levels depending on the result: no complaints (value 0), mild (1-3), moderate (4-6) and acute, severe pain or functional difficulty (7-10). Postoperative complications,if any, were also recorded, (wound infection, dehiscence of the sutures, slow recovery, paresthesia / anesthesia in the operated area, etc.).[26]For the conventional surgical frenulectomy, conventional technique according Archer [14]and Kruger [15]was used.To perform laser frenulectomyLaserHF® device was used, produced by the company Hager &Werken GmbH & Co.KG, which represents a combination of diode laser and a device with a high frequency with the following technical features: laser aPDT: 650 nm / 100 mW, diode laser: 975 nm / 6 W - cw / pulsed, HF monopolar / bipolar: 2.2 Mhz / 50 W, power supply: 230 V / 50 Hz.

Statistical analysis was performed in statistical program STATISTIC 7.1 and SPSS 17.0.

RESULTS

Demographic characteristics of the patients from both examined groups are shown in Table No.1 Average age of the patients from EG1 was 15.6 ± 6.8 years, min. 8 years old and max. 26 years old. Average age of patients from EG2 was 10.6 ± 3.1 years, min. 8 years old and max. 20 years old. In both examined groups the percentage of female gender was higher - in EG1 - 55.6% and in EG2 - 61.1%, and male gender in EG 1 was 44.4% and in EG 2 - 38.9%

Table 1: Demographic characteristics of the patients from both groups

	Age (mean value)	Gender %	
EG 1	15.6	F	55,6
		M	44,4
EG 2	10.6	F	61,1
		M	38,9

Table 2: Data regarding to frenulum

	Indication for frenectomy%		Frenulum type %		"+"papilla sign %		Morphology(lenth and width) Mean values	
EG 1	orto	44,4%	Type3	83,3	+	27,8	lenth	13,6
	perio	55,6%	Type4	16,7	-	72,2	width	1,8
EG 2	orto	94,4%	Type3	77,8	+	22,2	lenth	12,4
	perio	5,6%	Type4	22,2	-	77,8	width	2,1

Data about the indications for the intervention and morphological characteristics of the frenulum are given in Table No.2 Considering the indications for the frenulectomy, in EG1: periodontal indication was registered in 55.6%, and orthodontic indication was registered in 44.4%. In EG2 periodontal indication was registered in 5.6% and orthodontic indication was registered in 94.4%. We did not had other indications in our study. In both examined groups the rate of papillary frenulum type was highest in EG1 -83.3% and in EG2 it was 77.8%; trans-papillary type in EG1 was 16.7% and in EG2 -22.2%. In both study groups the highest registered rate of positive papilla was in EG1 - 72.2% and in EG2 - 77.8%. Ischemia of interdental papilla when raising the upper lip was registered in EG1 -27.8% and in EG2 -22.2%. Average length (from labial to gingival / papillary insertion) of frenulum in EG 1 was 13.6 ± 3.1 mm, min. 9 and max. 18 mm. Average length of the frenulum in EG2 was 12.4 ± 2.9 mm, min. 8 and max. 20 mm. Average width / thickness of frenulum in EG1 was 1.8 ± 0.9 mm, min. 1 mm and max. 3 mm; average width / thickness of the frenulum in EG2 was 2.1 ± 0.7 mm, min. 1 and max. 3 mm.

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Level of preoperative anxiety, postoperative pain and postoperative discomfort related to functional and mastication actions were notated with a numeric rating scale (Numeric Rating Scale NRS-11) [25] with values from 0 to 10, divided into 4 levels, depending on the result. Results are shown in Table No.3We found no connection between the mode of performed frenulectomy and the score for the fear. Average rate of preoperative fear level in EG1, according to the numeric scale, was 6.0 ± 2.4 (moderate fear). In EG2 it was slightly lower 4.6 ± 2.9 (moderate fear). On the third day of the intervention postoperative pain was assessed using a numeric scale (NRS-11) with values from 0 (no pain) to 10 (unbearable pain), divided into 4 levels depending on the result: no complaints (value 0), mild (1-3), moderate and acute (4-6), severe pain (7-10). Average rate of postoperative pain level in EG1, according to the numeric scale, was 3, 3±1, 5 (moderate pain). In EG2 it was 1, 3±1, 3(mild pain). According to t-test the difference between the average scores of postoperative pain it is statistically significant for $p < 0.05$ ($t = 4.199210$, $p = 0.000182$).

Table 3: View of patients in both treatment groups in terms of preoperative anxiety, postoperative pain and discomfort under numeric rating scale (NRS-11)

	Preoperative fear			Postoperative pain			Postoperative discomfort		
	Mean values	t-test	p	Mean values	t-test	p	Mean values	t-test	p
EG1	6,0	1.580		3,3±1,5	4.199		4,2	5.202	
EG2	4,6	1.580	>0.05 =1.58	1,3±1,3	4.199	<0.05 =000182	1,05	5.202	<0.05 =000009

Table 4: Data regarding to intervention (surgical versus laser)

	Infiltrative anestesia				Performing time		Suturing		Analgesia			
		n	%	p	Mean time	Mann-Whitney	n	%				p
EG1	yes	18	100		11,6 ±2,3		18	100	yes	7	38.9	
	no	0					0		no	11	61.1	
EG2	yes	14	77.8		6,1±1,9	p<0.05 (Z=4.745790, p=0.000002). <ooooo2	0		no	4	22.2	
	no	4	22.2	p<0.05 (p=0.0414)			18	100	no	14	77.8	p>0.05 (p=0.2844)

On the third day of the intervention postoperative discomfort connected to oral functions was evaluated using the numerical scale (NRS-11), with values from 0 (absence of functional difficulty) to 10 (seriously compromised oral function), divided into 4 levels depending on the result: no complaints (value 0), mild (1-3), moderate (4-6), and acute, serious difficulty function (7-10).The average score of postoperative discomfort regarding oro-facial function in patients from EG1 according to the numeric scale was 4.20 ± 2.2 (moderate discomfort), and with patients from EG2 the average score of postoperative discomfort was significantly lower 1.1 ± 1.2 (mild discomfort).Statistical analysis (t-test) showed that the difference between the average estimates of postoperative discomfort compared to the oral-facial function in patients is statistically significant for $p < 0.05$ ($t = 5.202108$, $p = 0.000009$). Results for data recorded during surgical procedure are shown in Table No. 4Surgical time was noted during the operations, measured from the moment of making the incision until the end of the intervention. Duration of the intervention with the conventional method was 11.6 ± 2.3 minutes, min. 8 and max. 15 minutes. Duration of the intervention with the use of laser was 6.1 ± 1.9 minutes, min. 3 and max. 10 min. Registered difference in the measured time between the two surgical methods (conventional procedure - longer, laser procedure - shorter) by Mann-Whitney U test is statistically significant for $p < 0.05$ ($Z = 4.745790$, $p = 0.000002$). There is no need for sutures in patients treated with laser -100%, but in patients treated with conventional surgical technique suturing is necessary -100%. 61.1% of the patients in EG1 did not take analgesics after surgery contrary to 38.9% of patients who took analgesics. 77.8% of the patients in the EG2 did not took analgesics after surgery contrary to 22.2% of patients who took analgesics. According to t -test, difference between the two studied groups is not statistically significant for $p > 0.05$ ($p=0.2844$). Results are shown in Table No. 4

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Intraoperative bleeding was classified as absent (no bleeding), scarce (bleeding spots), moderate (moderate) or intensive (profuse). In EG 1 -88.9% of patients with moderate bleeding were registered, and only 11.1% (two patients) had profuse bleeding. The other two modes of bleeding (absent and scarce) were not registered. In EG 2 absence of bleeding was registered in - 83.3% of patients, and scarce bleeding in 16.7%. Other two modes of bleeding (moderate and profuse) were not registered. Results are shown in Table No.5

Table 5: Intraoperative bleeding

Intraoperative bleeding	EG 1		EG 2	
	n	%	n	%
absent			15	83.3
scarce			3	16.7
moderate	16	88.9		
intensive	2	11.1		
total	18	100	18	100

DISCUSSION

Although the review of the literature is rich with many studies whose field of interest is maxillary labial frenulum, there are few studies that make comparisons between different treatment modalities for the frenulectomy. [27-29] Advancement of the science and technology imposes new treatment options and one among them is the use of lasers in oral soft tissue surgery. [19-31]

Our study included only cases of labial frenulum with type 3 and type 4 of insertion according the classification by MirkoPlacek at al. [10], having in mind that these types of frenulum are generally indicated for frenulectomy. The results we have gained, showed that patients treated with diode laser are completely absent with intraoperative bleeding, except in 3 patients where there was scarce bleeding, which is quite different from surgical frenulectomy where bleeding was recorded in all patients. In 88.9% of the patients we found moderate bleeding, and only 11.1% (two patients) had excessive bleeding (table 5). When laser frenulectomy is performed it is not necessary to suture the surgical wound and the recovery is by secondary intention, with the production of granulation tissue and reepithelization takes place from the marginal parts of the surgical wound to the center. [32, 33]According the Medeiros et al.[34], eliminating the need for suturing and avoiding trans operative bleeding, undoubtedly leads to reduction of the surgical time ($p < 0.001$). When lasers are applied in to the periodontal procedures (including frenulectomy), there is reduced bleeding as a result of the effect of hemostasis in the small superficial vessels with simultaneous decontamination of the surgical wound which helps in prevention of the infection. [35-37] According to t-test, the difference between average estimates of the level of preoperative anxiety is statistically insignificant for $p > 0.05$ ($t = 1.580581$, $p = 1.580581$). (Table 3).

Similar to our findings are the findings in the study of Medeiros et al.[34] , in both experimental groups moderately expressed fear has dominated but there is no statistical significant difference in the preoperative fear between the two groups (conventional surgery and Nd: YAG laser).The difference between the average grades of postoperative pain in patients of the two groups is statistically significant for $p < 0.05$ ($t = 4.199210$, $p = 0.000182$).Table 3 It is also suggested that the absence of immediate postoperative pain following oral muco-gingival laser surgery, may be due to laser irradiation that alters sensory nerve endings, and thus, they cannot develop anastomoses in between. [38]

Pie-Sanchez et al. [39] conducted a prospective comparative study, comparing two types of laser frenulectomy, half were performed with CO2 laser, and the rest with Er, Cr: YSGG laser. Cases treated with CO2 laser showed better results in terms of intraoperative bleeding and shorter surgical time, and on the other hand Er, Cr: YSGG laser enable faster recovery of the surgical wound. What is especially important is that in both cases, postoperative pain and edema were minimal or completely absent. The percentage difference in terms of postoperative need for analgesics between the two experimental groups was statistically insignificant for $p > 0.05$ ($p = 0.2844$) (table 4), which means that connection between the type of frenulectomy and taking analgesics postoperative is not registered. Our results differ from those of Kara [26], whose study showed that only 37 patients (92.5%) in the group treated with conventional procedure needed postoperative analgesics

but only 2 patients (5%) in the group treated with laser. Difference between the average P values for the postoperative discomfort in terms of the performance of orofacial function in patients in the two groups is statistically significant for p <0.05 (t = 5.202108, p = 0.000009)Table 3. Our finding is consistent with the study of Kara[26], where VAS scores for postoperative pain and postoperative chewing and speaking difficulties were evaluated at 3 hours, 1 day and 1 week postoperatively and they were significantly lower in the patients treated with laser contrary to the group of patients treated with conventional surgical procedure (p <o.o5). Similar results were obtained by Butchibabu et al. [40] where the evaluation of pain and discomfort were made by the same visual analogue scale (VAS),1th, 3th and 7th postoperative day, with significant lower values among patients treated with a diode laser. Most postoperative discomfort with the conventional frenulectomy is primarily due to the persistence of sutures in the first 7 days from the intervention and interference with the normal oral functions like speech and mastication. Unlike our findings, Medeiros at al. [34]have not registered statistically significant differences between the two methods in terms of postoperative pain and discomfort.

CONCLUSION

Advantage that we found in our study when diode laser was used for the frenulectomy, gives us light at the spot where we need to choose between two possibilities. We believe that further clinical trials will bring more evidence and to widen the frame for giving the wright decision about which procedure where and when should be used.

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