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Comparison between Diode Laser and Conventional Technique for Soft Tissue Oral Surgery: A Pilot Study.

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ABSTRACT

Diode laser for soft tissue oral surgery is becoming widely used due to its beneficial effects regarding sufficient haemostasis, precise incision margin, lack of swelling and pain. There is a lack of data regarding this topic, i.e. most of the studies that compared different surgical modes were performed in animals and most of them performed in the humans were without control group. The aim of this study was to compare diode laser and conventional scalpel surgery for the surgical treatment of oral soft tissue lesions with regard to oedema, haematoma, postoperative pain and patient's satisfaction. There were 16 patients in the study group (laser) and 13 in the control group (scalpel). Statistical analysis was performed with $\chi 2$ test and t test for independent samples, values lower than 0.05 were considered as significant. Patients treated with laser had significantly lower scores of oedema, haematoma and pain compared to the scalpel group. Furthermore, patients treated with laser expressed significantly higher satisfaction with the treatment compared to the scalpel group. We might conclude that diode laser provides better outcome for the surgical treatment of oral soft tissue lesions when compared to the scalpel surgery.

Keywords: diode laser therapy, soft tissue, oral surgery.

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INTRODUCTION

Diode laser surgery is becoming widely used for oral surgical procedures. In the past, there have been few studies reporting beneficial effects of diode laser therapy. As surgical cutting proceeds, the heat generated seals small blood and lymphatic vessels reducing or eliminating bleeding and oedema. Denaturated proteins within tissue and plasma give rise to a surface zone of a tenacious layer, termed „coagulum“ or „char“ which serves to protect the surgical wound from frictional or bacterial action [1]. Scalpel wounds do not cause any thermal damage but allow extravasation of blood and lymph, causing a more marked inflammatory response with resultant swelling and formation of a scab [2]. However, healing mechanisms after laser surgery depend on the laser parameters. Laser efficacy depends among other things on laser wavelength used. Shorter laser wavelengths (diode, 810 nm, 980 nm) transverse the epithelium and penetrate 2-6 mm into tissue, whereas longer wavelengths have minimal penetration into the tissue [1]. Additionally, studies with longer wavelengths show that there is a lack of fibroblast alignment associated with the incision line and consequent reduced tissue shrinkage through scarring [3]. Irrespective of the laser wavelength all soft tissue healing will be by secondary intention [1].

Therefore, the aim of this study was to compare high power diode laser and conventional surgery for surgical treatment of oral soft tissue lesions.

MATERIALS AND METHODS

This study was approved by the Ethical Committee of the School of Dental Medicine, University of Zagreb, Croatia. Twenty nine participants with oral fibromas (either on the buccal or labial mucosa) were involved in the study. The diagnosis was established based on clinical appearance of the lesion and confirmed by histopathological evaluation. Study group consisted of 5 men and 11 women, (age range 12-80, mean 44.3 ±21.2). Oral fibromas in the study group were treated with high power diode laser (Hager&Werken, Duisburg, Germany), layer of (Al-In-Ga-As-P) on a (Ga-As) substrate, using wavelength of 975 nm, Fibroma removal program, and power of 5W, continuous mode with the spot size of 0.1-0.5 mm. Control group consisted of 6 men and 7 women, (age range 15-67, mean 45.6 ± 16.9). All fibromas in the control group were treated with conventional scalpel double elliptic-shape excision and silk sutures (0.3 mm, Mersillk 3.0, Ethicon, New Jersey, USA). Local anestethic (Ubistesin^{TM}, 3M ESPE, Espe Plazt, D-82229 Seefeld, Germany) was administered to all patients before the procedure. Three days after the surgical procedure oedema, haematoma, postoperative pain and patient's satisfaction rate were assessed by the single examiner. After three weeks patients were recalled again to evaluate delayed postoperative complications.

Oedema was assessed as the presence of swollen tissue around incision line and was measured in millimetres using digital calliper (Neiko 01407A, Neiko Tools USA). Haematoma was defined as the presence of blood extravasation around the incision line and was measured in millimetres as well. Both oedema and haematoma were measured by the same digital caliper. Post-operative pain was assessed by the patients on 10 cm visual analogue scale (VAS, 0 – no pain at all; 10 worst possible pain). Patient's satisfaction after the procedure was assessed on VAS as well (0 – not satisfied at all; 10 fully satisfied).

Statistical analysis was performed with $\chi 2$ test for categorical and Mann-Whitney test for numerical variables. P-values lower than 0.05 were considered as significant.

RESULTS

No significant differences regarding age and gender of the participants were observed between the groups.

Table 1: Demographic and clinical characteristics of the participants.

	Laser	Scalpel	p
Gender N (%)			0.466
female	11 (68.8%)	7 (53.8%)	
male	5 (31.2%)	6 (46.2%)	
Age (mean ± SD)	44.3 ± 21.2	45.6 ± 16.9	0.859

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Patients in the study group had significantly lower oedema and haematoma scores compared to the patients in the control group (1.37±0.5 vs. 3.69±1.32 for oedema, 1.25±0.45 vs. 2.15±1.14 for haematoma) ($p<0.05$) (Figure 1).

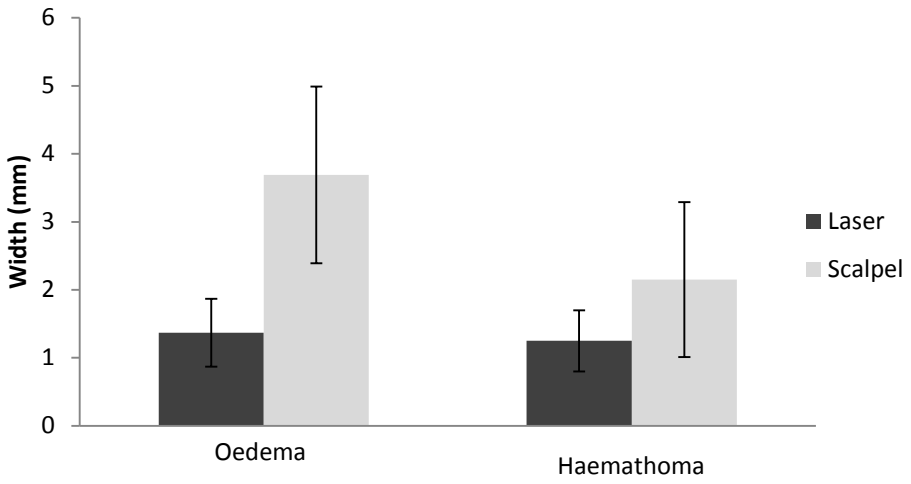

Figure 1: Differences in tissue oedema and haematoma between the laser and scalpel group.

Patients in the study group reported significantly lower pain and higher satisfaction rate compared to the patients in the control group (0.87±0.34 vs. 3.38±1.32; 9.00±0.63 vs. 7.61±1.19) ($p<0.05$) (Figure 2).

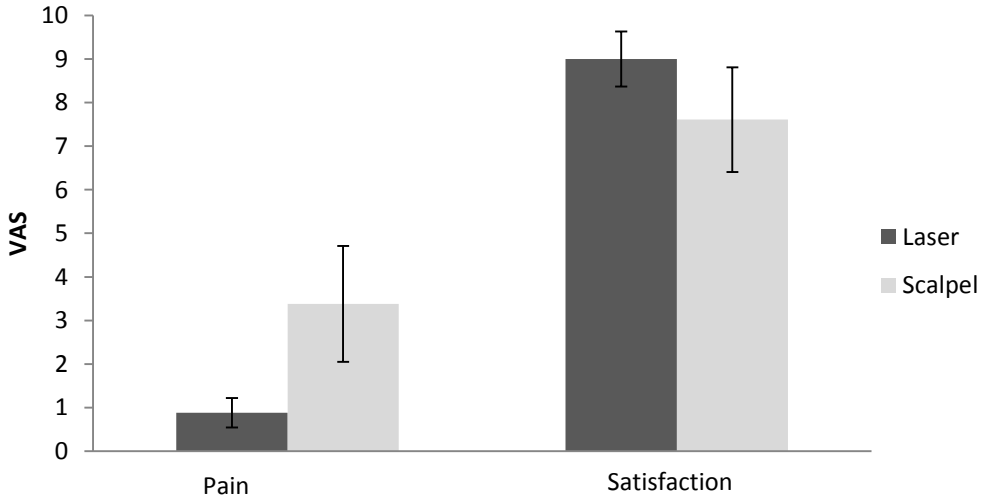

Figure 2: Differences in pain and satisfaction between the laser and scalpel group.

After three weeks patients were recalled again and no postoperative complications or healing complications were found in study group, as well as in control group.

DISCUSSION

There is a lack of data regarding comparison between high power diode laser and conventional intraoral surgery, i.e. most of the studies that compared different surgical modes were performed in animals and most of them performed in the humans were without control group.

D'Arcangelo et al. [4] reported that diode laser tends to produce more changes than scalpel with regard to the degree of inflammatory response and delay in tissue organization only at the initial stage. However, long term results of the diode laser on the tissue histology are not known. Histological analysis on rats performed by D'Arcangelo et al [4] showed that healing after laser surgery is not compromised but rather

slower and satisfactory when higher output power (6W) is used. Therefore, the same authors [4] concluded that lasers at lower output power (4W) reduce the effectiveness of the incision, but also minimise thermal damage of the tissue. The same authors [4] concluded that use of diode lasers should be further investigated as they are good alternative to scalpel incision and suture repair. Bryant et al. [5] evaluated wound healing of soft oral tissues after diode irradiation and concluded that the clinical application in oral surgical procedures had beneficial effect. Results of that study are consistent with the results of present study. The absence of bleeding significantly reduces postoperative swelling and discomfort and the absence of sutures can minimize the risk of distortion of anatomy [6]. There are only two studies in humans so far in the published literature which compare healing effects after carbon dioxide (CO_2) laser surgery and scalpel surgery [6,7].

Jin et al. [8] reported that diode laser is a good cutting device for oral mucosa, however, more tissue damage occurs than with the use of a scalpel or an Er, Cr:YSGG laser. Due to thermal-induced damage, laser as compared to the scalpel, tends to produce more pronounced tissue change. Such changes are associated with an increased inflammatory response and an initial delay in healing response.

Romanos and Nentwig [9] reported that diode laser (980 nm) was beneficial in 22 patients when treating soft tissue tumors, gingival hyperplasias, frenectomies, removal of haemangioma, vestibuloplasty and periimplant tissue surgery. The same authors [9] concluded that diode laser has postoperative advantages , i.e. lack of swelling, bleeding, pain, scar formation and good wound healing. However, their results were not compared to the other surgical procedures, because there was no any kind of control or comparable group. Furthermore, Stubinger et al. [10] investigated usefulness of diode laser in 40 patients. The same authors [10] concluded that postoperative clinical findings were excellent due to the sufficient cutting abilities, good coagulation effect and extremely small zone of thermal necrosis to the nearby tissues. Results of that study are consistent with the results of present study.

CONCLUSION

Based on the results of our and other authors' studies we might conclude that high power diode lasers should be employed in everyday oral surgical procedures due to coagulation effect, sterilization of the surgical site, minimal or no swelling and significantly reduced postoperative pain.

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