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Comparison of laser and cautery in maxillofacial surgical procedures: An original research

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Abstract---Aim: The purpose of the present study was to evaluate the comparison of laser versus cautery usage in various maxillofacial surgical procedures. Methodology: In this randomized double-blind clinical trial, 40 individuals were randomly allocated to two groups: group 1 (G1) consisted of 20 individuals assigned to treatment with diode laser and group 2 (G2) consisted of 20 individuals assigned to treatment with electrocautery. The following transoperative

parameters were evaluated: bleeding, temperature, and surgical technique parameters (energy deposited on tissue, flow rate, and time of incision). The postoperative parameters evaluated were as follows: pain, functional alterations (chewing, speaking), analgesic medication intake, swelling, healing of the wound area, and patient satisfaction. Results: Among the 40 individuals included in the study, four (two in G1 and two in G2) did not complete the entire follow-up. Therefore, 36 individuals (18 in G1 and 18 in G2) participated. Participants in G1 and in G2 had similar demographic characteristics. No difference regarding the trans- or postoperative parameters evaluated was observed between G1 and G2 ($p > 0.05$). Also, no difference regarding the time for healing was observed between groups. Conclusion: Diode laser seems to be as effective and safe as electrocautery when applied under similar conditions.

Keywords---cautery, clinical trial, diode laser.

Introduction

Laser is a monochromatic, collimated, coherent, and intense beam of light produced by stimulated emission of radiation of a light source. Lasers are classified according to different factors among which is the classification based on laser active medium such as gas, liquid, solid and semi-conductor, which identifies and distinguishes the type of emitted laser beam.[1] The properties of a specific laser beam, particularly wavelength and the optical characteristics of the particular target tissue determine the type and the extent of interaction which may occur Low level laser therapy (LLLT) which has therapeutic effects without inducing a lot of heat is established in clinical dentistry because of its anti-inflammatory, bio stimulant and regenerative effects. Its use has been widely reported with satisfactory results in the literature.[2] The recently rapid developments in laser technology and better understanding of bio-interactions of different laser systems have broaden the clinical use of laser in dentistry.[3] Common lasers used in oral surgeries are CO2, Er.

Family, Diode and Nd:YAG. Also low level lasers are used in assisting the procedures of disinfection and healing. Whereas to obviate the inherent disadvantages of steel scalpel, surgical diathermy was introduced at the beginning of the 20th century.[4] With the advent of modern electrosurgical units, this technique is now becoming extremely popular because of rapid hemostasis, faster incision, and reduced overall operative blood loss.[5] Electrosurgery has been defined as the intentional passage of high-frequency waveforms or currents through the tissues of the body to achieve a controllable surgical effect.[6] Electrocautery involves current frequencies in the range of 400 KHz–10 MHz. Currents up to 500 MA can be safely passed through the patient. Electrocautery may be either monopolar or bipolar. Monopolar electrocautery is more commonly used than bipolar electrocautery. In monopolar electrocautery, high frequency current from an electrocautery machine is delivered to an active electrode held by the surgeon. Density of the current is high, where the electrode touches the body tissues and a pronounced local heating effect occurs.

The current subsequently spreads out in the body and then returns to the diathermy machine through the patient plate electrode (a pad which is kept under the patient).[7] Different types of electrode tips are used for different purposes such as ball tip for coagulation and blade tip/needle type for incision or excision of tissues.[8] Laser has played an increasingly important role in oral surgery because of the high absorption of water and hemoglobin obtained with it enhances cutting and coagulation capability.[9] The diode laser with semiconductors, however, has been widely used due to its characteristics of portability, compactness, and low costs compared with other types of laser.[10] Electrocautery also provides improved hemostasis, but the mechanisms involved differ from those of laser. Despite the thermal damage it causes, it enhances hemostasis by means of blood vessel sealing before cutting. The mechanism of electrocautery is based on a monopolar electrical current heating up a metal probe that is then applied to the tissue, promoting coagulation and cutting.[11] Because no heat reaches deeper tissues, electrocautery is more suitable for the destruction of superficial tissue layers.[12] Though less precise than laser in cutting, electrocautery is not only faster and less costly, but also provides better hemostasis.[13]

Aim of the present study

The purpose of the present study was to evaluate the comparison of laser versus cautery usage in various maxillofacial surgical procedures.

Methodology

The present study was a randomized, double-blind clinical trial in which the participants and the assessor were blind to group assignment. The study was approved by the Ethics Committee and the patients gave written informed consent for the publication of the study in agreement with the Declaration of Helsinki. Individuals ≥ 18 years old with Inflammatory Hyperplasia (IFH) caused by dentures were included. The diagnosis of the lesion was carried out by means of clinical examination and was based on the following characteristics: painless/pain exophytic lesion with single or multiple flanges of any size, pale or erythematous, and of fibrous to flaccid consistency in the oral region and directly associated with ill-fitting dentures. Individuals with parafunctional habits, with systemic problems such as uncontrolled hypertension and diabetes mellitus, as well as individuals with depression, and those taking anti-coagulant medication, analgesics/antipyretics, or anti-inflammatory drugs were excluded from the study.

The participants were randomly divided into two groups. Group 1 (G1): 20 individuals who underwent surgery using a diode laser. Group 2 (G2): 20 individuals who underwent surgery using electrocautery. Laser specifications were as follows: 808 ± 10 nm and active medium of Gallium-Indium-Arsenide (GaInAs) and Electrocautery energy specifications were as follows: monopolar cautery (Electric scalpel Emai BP100-Plus 100 W. Participants from both groups were instructed not to wear the dentures for a period of 2 weeks before treatment in order to reduce inflammation and chronic pain. The lesions were removed by excision with the diode laser and the electrocautery in the G1 and G2 groups, respectively. A suture was not performed due to the hemostatic nature of both

procedures. Bleeding was evaluated according to a modified scale, i.e., absent (no bleeding), mild (minimal bleeding), moderate (normal bleeding, if a scalpel was used), and intense (excessive bleeding). For postoperative pain, functional alterations (chewing and speaking), analgesic medication intake, and swelling, five sets of measurements were recorded: shortly after surgery and on the 7th, 14th, 21st, and 28th day of postoperative follow-up.

For the evaluation of postoperative pain, the participants were asked to indicate the degree of pain on a 10-cm visual analog scale (VAS).[14] The end-points of the scale displayed "no pain" on the left side (0) and "worst pain imaginable" on the right side.[15] The degree of swelling could be recorded as follows: absent, mild, moderate, or severe. Healing was evaluated by measuring the postoperative wound areas, i.e., shortly after surgery as well as on the 7th, 14th, 21st, and 28th day of postoperative follow-up. The wounds' areas (mm^2) were measured with a millimeter ruler in their largest and smallest diameter. Statistical analysis was performed using the Statistical Package for the Social Sciences software (SPSS), version 22.0. Comparisons of trans- and postoperative parameters between G1 and G2 were also performed by the chi-square and the Mann–Whitney tests. The comparison between G1 and G2 regarding the time of healing (in days) of the postoperative wounds was carried out using survival analysis (the Kaplan–Meier method) and applying the log-rank test. The level of significance was set at $p < 0.05$ in all analyses.

Results

Among the 40 individuals (20 in G1 and 20 in G2) included in this randomized clinical trial, four (two in G1 and two in G2) did not complete the entire follow-up. Therefore, data for 36 individuals (18 in G1 and 18 in G2) were submitted to statistical analysis. In G1, six individuals were males (33.3%) and 12 were females (66.7%). In G2, four individuals were males (22.2%) and 14 were females (77.8%). The mean age of the participants was 58.6 (± 11.0) years (range: 44 to 74 years) in G1 and 63.3 (± 9.6) years (range: 49 to 76 years) in G2. (Table 1) Only one individual in G2 presented intense bleeding. No difference regarding the amount of analgesic intake over the study period was observed between G1 and G2 ($p > 0.05$). This finding ensured the reliability of pain assessment. No differences between groups were observed for the following postoperative parameters: pain, swelling, difficulty in speaking and chewing, and wound area ($p > 0.05$). All G1 and G2 subjects were equally fully satisfied with how they were treated by the staff and the surgeon, with the surgical technique used and with the result of treatment after complete clinical healing of the postoperative wounds ($p > 0.05$). (Table 2)

Discussion

The aim of the present study was to evaluate and compare the efficacy and safety of diode laser surgery and electrocautery surgery for the removal of IFH. The null hypothesis was accepted. The two techniques were equally effective in removing IFH successfully and safely, since no difference in bleeding, swelling, pain, or in technical parameters was observed. Moreover, the two techniques were fairly similar in terms of patient satisfaction. This result was probably due to the

similar conditions of the clinical equipment since the electrocautery tip used was a 0.4 mm-thick needle with an intended closer correspondence to the laser tip. The prevalence of complete edentulism (loss of all permanent teeth) among adult individuals varies between 7 and 69% worldwide.[16]

Research demonstrating the ill effects of wearing dentures dates back to more than 5 years.[17] The illeffects are primarily related to the presence of soft tissue lesions, such as IFH, and to the development of candidiasis induced by wearing the dentures. The treatment indicated for IFH is surgical excision with appropriate prosthetic reconstruction. Recent studies have reported promising results with excellent functional and cosmetic outcomes and minimal side effects using high-power laser for the treatment of IFH.[18] Herein, we have demonstrated that diode laser and electrocautery are both valuable tools for the excision of oral soft tissue lesions with a short transoperative time and low postoperative features, plus patient satisfaction. Amaral et al. compared the use of diode laser to scalpel surgery, showing the greater effectiveness of laser over scalpel in the treatment of IFH.[19] Diode laser-assisted surgeries are easily performed with less discomfort, minimal or no bleeding due to the sealing of blood vessels by protein denaturation and stimulation of clotting factor VII production, and shortened healing time with reduced postoperative bleeding and swelling.

CO2 and Er:YAG lasers are also valuable tools for IFH excision. However, due to the thermal effect, tissue integrity was better preserved after the use of Er:YAG compared to CO2. Laser and electrocautery involve different operating principles for tissue cutting. Laser operates by means of a coherent, monochromatic, and collimated light, increasing temperature and protein denaturation. Electrocautery, on the other hand, uses a mechanism of electric current causing a thermal injury. Laser produces some degree of liquid volatility and a surrounding zone of thermal necrosis, promoting sterilization of the surgical area. Moreover, this technique has bactericidal effects, which may contribute to the reduction of inflammation. Electrocautery also produces adequate hemostasis. However, its mechanism results in greater thermal injury and might cause muscle fasciculation. Furthermore, electrocautery has no self-sterilizing property.[20] In the present study, no difference between the two surgical techniques was observed even regarding the surface temperature parameter. The cost of laser for acquisition and therapy is higher than the cost of the electrocautery. Therefore, if the clinician and the maxillofacial surgeon adopt the electrocautery in their practice, they might be able to achieve the same treatment success for IFH removal with a lower-cost equipment.

Conclusion

In summary, no significant difference between diode laser and electrocautery was observed in this double-blind study in the evaluation of trans- and postoperative parameters for the removal of IFH. Under similar conditions, the use of diode laser is as effective and safe as electrocautery in the IFH treatment.

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Tables

Table 1
Sociodemographic data of the participants with inflammatory fibrous hyperplasia

Sample		G1 (Diode laser)	G2 (Electrocautery)
Gender, n (%)	Male	6 (33.3)	4 (22.2)
	Female	12 (66.7)	14 (77.8)
Age in years (range; mean) ± SD		44–74; 58.6 ± 11.0	49–76; 63.3 ± 9.6
Smoking, n (%)	Non-smoker	16 (88.9)	16 (88.9)
	Smoker	2 (11.1)	2 (11.1)

Table 2
Assessment and comparison of trans-operative parameters between groups submitted to surgery using a diode laser (G1) or electrocautery (G2)

Trans-operative parameters	G1 (diode laser)	G2 (electrocautery)	p value
Bleeding, n (%)			
Absent	11 (61.1)	8 (44.4)	0.523
Mild	5 (27.8)	8 (44.4)	
Moderate	2 (11.1)	1 (5.6)	
Intense	0 (0.0)	1 (5.6)	
Pain; range (median), mean			
1st day	0–10 (0.0), 2.78	0–7 (3.0), 2.72	0.808
28th day	0–0 (0.0), 0.0	0–0 (0.0), 0.0	0.999
Swelling on the 1st			

day, n (%)			
Absent	2 (11.1)	5 (27.8)	0.195
Mild	9 (50.0)	9 (50.0)	
Moderate	4 (22.2)	3 (16.7)	
Intense	3 (16.7)	1 (05.6)	
Swelling was absent on the 21st and 28th day, n (%)	18 (100.0)	17 (94.4)	0.999