Comparative evaluation of wound healing after ErCr:YSGG laser gingivectomy over conventional scalpel gingivectomy

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Abstract

Introduction: In this scientific era of high technologic advancement, lots of progress has been made in the field of dentistry. LASER is one of the most important latest additions in the existing list of advanced equipment. In the last 3-decades laser have made a mark in the field of medicine as a useful alternative to conventional method of therapy as well as in dentistry too.

Aims and Objectives: The aims and objectives of present study was to evaluate the wound healing after ErCr:YSGG laser gingivectomy over conventional scalpel gingivectomy.

Materials and Methods: Twenty patients (20) with a total of Forty (40) quadrants of gingival enlargements were selected for external bevel gingivectomy. Patients divided into following groups: Group-A (Test Group) After phase1 therapy remaining suprabony pocket /enlarged gingiva removed by laser gingivectomy using Er,Cr:YSGG laser in 20 patients. Group-B (Control Group): After phase1 therapy remaining suprabony pocket/enlarged gingiva removed by conventional scalpel gingivectomy in 20 patients. Wound Healing were evaluated at 1st, 2nd, 3rd, 7th, 14th, 28th day after gingivectomy.

Results and Conclusion: All peroperative and postoperative records were compared between test & control groups.No statistically significant difference found in healing between laser gingivectomy and scalpel gingivectomy but to draw a definite conclusion regarding the wound healing efficacy of Er,Cr:YSGG lasers, further study involving higher number of samples are warranted.

Keywords: Gingival enlargement, Er,Cr:YSGG laser, Ninhydrin, Gingival crevicular fluid, Carbonization.

Introduction

In this scientific era of high technological advancement, lots of progress have been made in the field of dentistry. Lasers have emerged as one such most important addition in the advances made so far. Laser stands for '*Light Amplification by Stimulated Emission of Radiation*'. The first laser device, Ruby laser was invented by Maiman in 1960, based on theories advocated by Einstein in the early 1900s.[1] Laser treatment is expected to serve as an alternative or adjunctive to conventional mechanical periodontal treatment. Currently, among the different types of lasers available, *Er:YAG* and *Er,Cr:YSGG* (2780nm) lasers possess characteristics suitable for dental treatment due to its dual ability to ablate soft and hard tissues with minimal damage. Many researchers have claimed the superiority of laser surgery over traditional methods.So it has become an important issue to access the advantages of laser surgery over traditional scalpel surgery.

Materials and Methods

For carrying out the present study, the subjects were selected from the outpatient department of Periodontics, Dr. R. Ahmed Dental College and Hospital, 114, A. J.C Bose Road Kolkata-14. All patients were explained about the study and an informed consent was obtained from them. Ethical committee clearance was obtained before starting the study.

Subject Selection: Patients of both sexes, age group ranging between 18-45 years with good general health and oral hygiene habit, not taken any systemic antibiotic since the last six months were included in the study. Patients with moderate to advanced periodontal destruction with suprabony pocket ≥5mm in depth or gingival enlargement in which bottom of pockets not apical to mucogingival junction were included in the study.

Study Design: Primarily the present study was designed as prospective controlled clinical trial. Twenty(20) patients with a total of forty(40) quadrants of gingival enlargement were selected for external bevel gingivectomy. The surgical areas covering not less than three teeth were included in the study. The selected sites were randomly divided into test group and control group and were treated according to split mouth design technique as follows:

Group-A (Test Group): After phase-1 therapy remaining suprabony pocket / enlarged gingiva removed by laser gingivectomy using *Er,Cr:YSGG* laser in twenty (20) patients.

Group-B (Control Group): After phase-1 therapy remaining suprabony pocket / enlarged gingiva removed by conventional scalpel gingivectomy in twenty (20) patients.

Armamentarium: In control group conventional gingivectomy performed by using Bard Parker Handles with No. 11 and 15 blades, Crane Kaplan Pocket Marker, Kirkland Knife, Blake's Handle, Orban Knife, Tissue Forceps and Curettes. In test group Laser gingivectomy was performed by using Er,Cr:YSGG Laser (Waterlase) with Tips (T4,G6).

Pre-surgical Consideration: All patients were subjected to a thorough initial mouth preparation, oral hygiene instructions, scaling, root planing and polishing etc. at least one week before surgery to minimize gingival inflammation so that identical clinical pictures exists in all surgical areas in the same mouth.

Surgical Procedures

a) Scalpel Gingivectomy: Following administration of local anaesthetic agent (Lignocain HCl 2% with Adrenalin 1:100000), pocket depth marked with the help of pocket marker facially and lingually. External bevel gingivectomy was performed as described by GOLDMAN.[2]

b) Laser Gingivectomy: Following administration of topical anaesthetic (Lignocaine aerosol 15% w/w) over surgical area, pocket was explored and marked with pocket marker. Proper eye protection was employed. Laser gingivectomy was performed utilizing the Er,Cr:YSGG laser (2780nm) with a T4 & G6 sapphire tip, 0.5 W, 11% Air, 7% water. Excess gingival tissues were reduced in a motion very similar to festooning of gingiva. The calculi and necrotic cementum were removed, the root surfaces were smoothened using scalers and curettes after which the areas were cleaned and washed with normal saline. Aluminium foil was placed over the surgical area in both test and control group before ZOE periodontal dressing, isolating the surgical area from direct contact of dressing.

Post-Surgical Consideration: Patients were under proper antibiotic coverage and advised to take 1 Tab Acetaminophen (Paracetamol) 500mg only in case of pain. Patients were recalled at 1st, 2nd, 3rd, 7th, 14th and 28th day post-surgery. At each of the recall visits, oral hygiene was assessed and oral hygiene instructions were reinforced. All postoperative recordings were compared with preoperative pictures recorded just before surgical interventions on a carefully prepared history sheet utilizing same parameters.

Parameters Studied

Healing of Wound: At every post-surgical recall visit healing was evaluated using following parameters:

a) Plaque Index: Amount of plaque present were measured using Plaque Indices (PI) of Sillness and Loe (1964)[3]

b) *Gingival index:* Gingival index of Loe and Silness (1963).[4]

c*)* Gingival Crevicular Fluid Flow: Gingival fluid was collected prior to surgery and at 7th, 14th, 28th day postoperatively, according to the method of Loe and Holm-Pederson[5] (1965):

1) Mouth Preparation and Gingival Crevicular Fluid Collection*:* The facial and lingual surfaces of the teeth and gingiva were carefully dried with gauze. Whatman No.1 filter paper strip 1.5mm wide ×10mm long were used to determine fluid index.**[6]** A filter strip was gently placed at the entrance to gingival crevice after 30 seconds had elapsed from the time of drying the tissue and left for exactly 3 minutes.**[7]**This time (30seconds) interval was used to allow the physiologic reestablishment of sulcular exudate flow.

2) Staining: An alcoholic solution of 0.2% Ninhydrin was used for staining. Ninhydrin is chemically a triketohydrindene hydrate that react with amino acid specifically with alpha-amino acid, an important protein component of gingival fluid to yield a blue or purple colour.

d. Wound Evaluation (Clinical)-The operated areas were inspected at every recall visit after removing dressing for any excess granulation tissue, denuded bone, extent of epithelialization and sloughing only by the look of operated area. Wound Evaluation Scoring (On Visual Inspection of Wound) 1) Epithelization: 0-Satisfactory, 1-Unsatisfactory, 2) Slough (Amount of slough on surgical area):0- Absent, 1-Slight, 2 -Slight to Moderate, 3-Moderate

Histological wound evaluation: In one patient gingivectomy sites were biopsied from the test and control group on 28th day after gingivectomy. Biopsy were performed by incising a gingival strip of about 2×10 mm in dimension. (Stahl et al 1968) Gingival specimens were placed in 10 percent neutral buffered formalin and sent to Dept. of Oral Pathology, Dr. R. Ahmed Dental College & Hospital Kolkata for histologic evaluation.[8]

Statistical Analysis

Statistical analysis was employed to compare the study results using a computer software program (SPSS 11.0 version). To determine the differences in the distribution of various parameters in test and control groups the Contingency Chi-Square Test were utilized. Chi-square and p values were obtained with appropriate level of significance.

Results and Analysis

Wound evaluation:

Plaque Index on baseline and postoperative days were seen to be nonsignificant ($p>0.05$) with either of the techniques.

Gingival Index scores were statistically identical on 7th, 14th & 28th postoperative day ($p>0.05$).

Gingival Crevicular Fluid: Gcf flow was greater on 7th, 14th, 28th postoperative day with laser gingivectomy in comparison to scalpel gingivectomy at ($p >0.05$) statistically nonsignificant.

Epithelization: While evaluating wound considering epithelization shows comparatively more epithelization on 7th postoperative day with scalpel gingivectomy but the results were not statistically significant($p<0.05$). In laser group 20% cases showed complete epithelization while in scalpel group 60% cases presented with complete epithelization on 7th day after gingivectomy. (Diagram 1)

Slough Accumulation: The distribution of slough accumulation over tissues were observed to be statistically significant at ($p <0.01$) on 1st day after gingivectomy. Slough was also seen to be more with laser gingivectomy on 2nd, 3rd and 7th postoperative days but the results were statistically not significant. (Diagram 2)

Histologic evaluation at 28th postoperative day revealed normal looking stratified epithelium in the gingival specimen of both test and control group. In scalpel gingivectomy group edematous connective tissue with slightly increased amount of vascular channels was observed. Overall no significant difference in the inflammatory status found between the laser and scalpel gingivectomy groups. (Fig. 1 & Fig. 2)

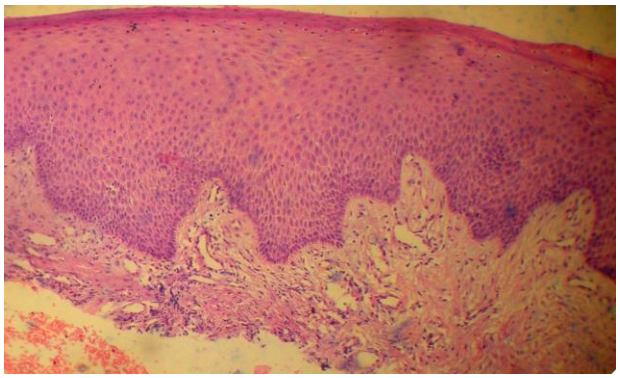


Fig. 1: Microscopic picture of gingival specimen on 28th day after scalpel gingivectomy (control group) showing normal looking stratified squamous epithelium, edematous connective tissue with slightly increased amount of vascular channels

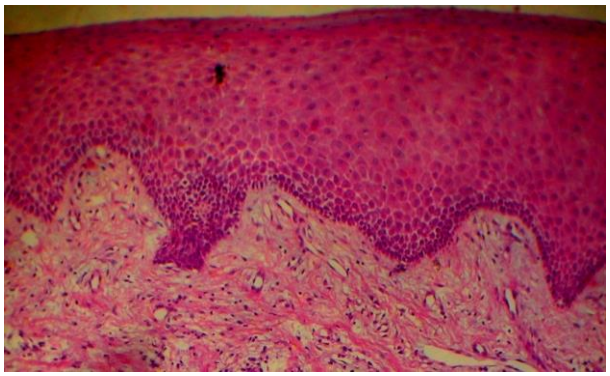


Fig. 2: Microscopic picture of gingival specimen on 28th day after ErCr,:YSGG laser gingivectomy (test group)showing normal looking stratified squamous epithelium with fine collagenous connective tissue.

Diagram 1: Showing distribution of epithelization on postoperative (day1, 2, 3, 7, 14 & 28) in test & control groups

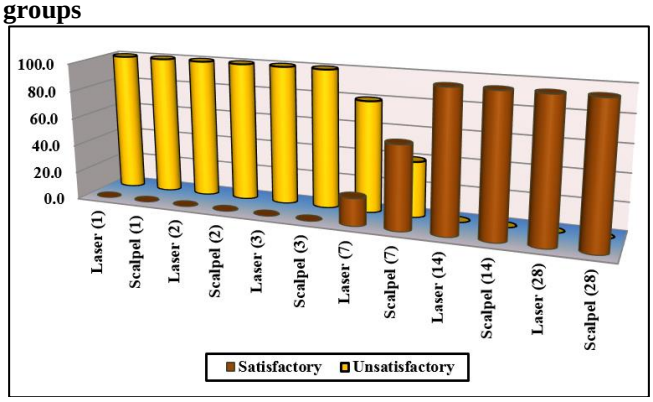
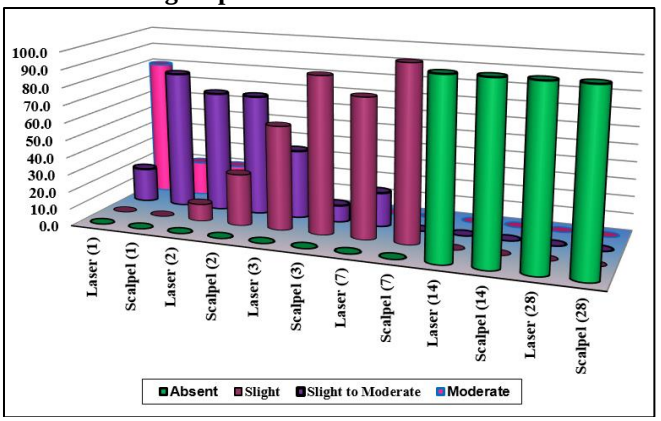


Diagram 2: Showing distribution of slough accumulation over tissues on postoperative (day1, 2, 3, 7, 14 &28) in test & control groups



Discussion

In the present study Er,Cr:YSGG laser was used having wavelength of 2780nm emitted in a free running pulse mode through fiberoptic delivery system. These wavelengths are well absorbed by hydroxyapatite and water of the target tissue, making the Er,Cr:YSGG laser suitable for both soft and hard tissues.[9] In the present study mean plaque scores were observed at baseline and during postoperative days. Chi-square values were statistically not significant between the test and control groups.

The mean plaque scores had increased in both the group during the first seven postoperative days. This may be explained by the fact that lack of manual dexterity on the part of the subject of the study to maintain their oral hygiene properly during the postoperative days. The mean plaque index was decreased in both the groups on day 14 indicating that all the patients learned to maintain their oral hygiene properly over time when they followed the strict oral hygiene instructions and motivation to do so.

Gingival index is the index of choice as bleeding is a more objective indicator than early gingival color changes. Distribution of mean gingival index scores were more with the test groups on postoperative days but results were statistically nonsignificant. This slight difference in the mean gingival scores may be attributed to host inflammatory response under the healing phase of the wound found in the test group.

Gingival crevicular fluid flow has been considered as a more objective method of evaluating the degree of inflammation[10] and found to be strongly correlated with the degree of inflammation. In the present study, Loe and Holm-Pederson's modified method of intra crevicular fluid collection was utilized. In this method absorbing filter paper strips were placed just at the entrance of pocket to pick up the fluid seeping out while irritation to the sulcular epithelium or to the base of the pocket.[11] It was observed that the gingival crevicular fluid flow were increased at 7th postoperative day and then gradually decreased on 14th and 28th postoperative days. Results of the present study were similar with the previous studies that flow increased with

the degree of inflammation. The gingival fluid flow attained its highest value on 7th postoperative day and then gradually decreased with advancement of healing. Gingival fluid flow was found to be slightly more with the test group compared to control group. However the result was statistically not significant. Increase in gingival crevicular flow may be explained with increased GI scores in test group compared to control group.

While evaluating the wound none of the surgical site exhibited excess granulation tissue and bone denudation. Similar results were also observed by Liboon et al in 1997.[12]On clinical inspection of the wound on postoperative days, comparatively more epithelization was observed in the control group at 7th postoperative day. On 7th postoperative day 60% cases of control group showed complete epithelization while 20% cases of test group presented with complete epithelization. Complete epithelization was seen with both the groups on 14th postoperative day. Fisher et al in 1983 studied the wound healing after CO_2 laser irradiation observed that laser wound tend to show less collagen formation, little wound contraction and slower epithelial regeneration compared with conventional surgical wounds.[13] It was opined that delayed epithelization of laser wound may be due to inhibitory substances produced by necrotic tissue, physical hindrance caused by the presence of eschar or heat fixation of adjacent epithelial cells.[14]

Statistically significant ($p<0.01$) distribution of slough accumulation over tissues were observed on 1st postoperative day with the laser group. On 2nd, 3rd and 7th postoperative days slough accumulation were also comparatively greater with the test group. Moreno et al in 1984 indicated that scalpel cuts are superior in terms of reducing slough accumulation compared to laser.[15] Camillo et al in 2007 reported the disadvantage of laser system as histologically evident thermal destruction around the laser beam incision. Thermal damage may range from a transient heating to protein denaturation, water evaporation, carbonization or burning.[16]

Histopathological examination revealed complete epithelization in both the laser and scalpel gingivectomy wound on 28th day after gingivectomy. In case of scalpel gingivectomy edematous connective tissues with slightly increased amount of vascular channels showed that there was still swelling relative to laser gingivectomy wound. Similar findings were also reported by Camillo et al in 2007. Considering the inflammatory status at 28th day after gingivectomy there was no significant difference observed between the test and control group. The reason behind this may be because healing was almost completed in both test & control groups by the end of 28th day of gingivectomy.[17]

Conclusion

In the present study there was no any statistically significant difference found in wound healing between laser gingivectomy and scalpel gingivectomy but to draw a definite conclusion regarding the wound healing efficacy of Er,Cr:YSGG lasers, further study involving higher number of samples are warranted.

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