

Periodontal flap closure using laser tissue bonding - A case report

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Abstract

Numerous methods and materials have been proposed to achieve optimum and efficient wound closure in various periodontal surgeries. Conventional suturing is considered as gold standard, but has certain limitations like being time-consuming, additional visit for suture removal, possible risks like wound dehiscence and adverse effects like needle prick injuries and foreign body reactions. A new technique called laser welding is seen to improve tissue closure when compared with conventional technique. This case report includes two cases in which Laser welding was employed for closure. Two patients indicated for periodontal flap surgery were included. After thorough debridement, closure was achieved by laser tissue bonding (LTB) using a 980 nm

Diode laser at power of 1.5 W. This can be a new promising technique which can be utilized as an alternative to conventional suturing.

Keywords: Flap surgery, Laser, Laser tissue bonding, Laser welding, LTB, primary closure

Introduction

Proper wound closure holds an enormous importance in periodontal flap surgery. It is a century old result that healing with primary intention is superior than secondary intention and results in faster wound healing as well as less patient discomfort.¹ Sutures have received a higher degree of attention and being routinely used since a long time. Tensile strength gained by suturing is helpful in providing the mechanical stability to the flap.² Although it is an optimum way of achieving primary

closure, it has shown some limitations like, time consumption, inflammatory response from breakdown products of the absorbable suture material, risk of needle prick injuries. Wicking effect is one of the many problems which can cause postoperative infection and can hamper the treatment outcome. Another issue with suturing is an extra visit for suture removal.³

Many techniques have been employed to overcome all these downsides. This includes use of autologous fibrin glue, tissue adhesives such as cyanoacrylate tissue adhesive (PeriAcryl).⁴ For such materials, although suturing is not required, the tensile strength gained during healing is found to be less than that of suturing. Apart from this, cyanoacrylate tissue adhesive is quite expensive.

Recently, Rasca et al³ used a new technique- laser welding as an alternative to suturing. Laser welding (LTW) is chiefly a photothermal process in which laser light is absorbed by chromophores in the tissue such as water, hemoglobin, and melanin and converted to heat. As the laser energy is converted into heat, it induces molecular thermal changes. When a sufficient number of tissue molecules are altered, bonds are established between the flap edges and the opposing alveolar bone. But the welding procedure came with some backfalls- poor tensile strength and collateral damage. To overcome these disadvantages, Gowda and Kumar⁵ modified the technique in which they used photosensitizer dye to increase the absorption of light and reduce the collateral damage, and, albumin was introduced as a solder to increase the tensile strength of the flap. This method was called as Laser tissue bonding (LTB).

As beneficial as this new method sounds, again has a small drawback i.e., the high cost of commercially available albumin. Therefore, in the following cases, we

used egg white as a substitute to the albumin available in the market. Egg white is an excellent source and contains abundant amount of albumin. It has been used in nerve and blood vessel repairs earlier and shown a good tensile strength superior or equivalent to that of suturing.⁶ Hence, we tried this technique in periodontal flap surgery as an alternative to suturing.

Case report

This was a split mouth study which included two patients who were indicated for periodontal flap surgery. Patients were explained about the procedure and informed consent was obtained from both the patients. In each patient, closure was achieved using laser tissue bonding (LTB).

In both the patients, thorough clinical examination and necessary investigations (X-ray, blood investigation) were carried out. On the day of the surgery, after administration of local anesthetic solution, sulcular incision was given and mucoperiosteal flap was reflected. Thorough debridement was carried out and the surgical site was irrigated with copious amount of 5% povidone iodine. This was followed by flap closure using LTB. In this process, first a photosensitizer dye- Indocyanine green (ICG) was delivered to the site. After 30 seconds, excess dye was flushed out with normal saline. This was followed by application of egg white on flap margins and inner surface using applicator stick and the flaps were adapted over the hard tissue. Irradiation using diode laser (Biolase- 940 nm) was carried out in continuous wave mode at 1.5 W for 30 seconds for 1 mm spot size in non- contact mode. After surgery, patients were prescribed analgesics and instructed to follow oral hygiene measures. Both patients were recalled on 7th day for suture removal and follow up.

Case 1

22-year-old female reported to department of Periodontics, KLE VK institute of Dental Sciences, Belagavi, Karnataka with a chief complaint of bleeding gums and mild sensitivity with all teeth. Patient did not report any relevant medical history. On clinical examination, there were generalized periodontal pocket present with 5-7 mm depth, soft edematous gingiva and grade I mobility was seen with majority of the teeth. Diagnosis was given as generalized Stage II Grade C periodontitis based on World workshop 2017 classification.⁷ Phase 1 therapy was carried out for this patient which included ultrasonic scaling and root planing and 0.2% Chlorhexidine mouth rinses twice daily for 14 days. Patient was recalled for follow up after 14 days. Inflammation had reduced indicating patient had responded well to phase 1 therapy. Considering persistent pockets and alveolar bone loss, this patient was taken up for periodontal flap surgery. After flap reflection and thorough debridement, closure was carried out using LTB was carried out in II quadrant (21 to 22 region) and III quadrant (31 to 38 region)



Fig. 1: Preoperative view



Fig.2: Flap reflection & debridement



Fig.3: ICG dye application



Fig. 4: Application of egg white



Fig.5: Irradiation with Laser



Fig. 6: Immediate postoperative view



Fig.8: Preoperative view



Fig.7: 7th day Postoperative view



Fig.9: Flap reflection & debridement

Case 2

20-year-old female patient reported to department of Orthodontics, KLE VK Institute of Dental Sciences, Belagavi, Karnataka with chief complaint of forwardly placed teeth. Patient was referred to department of Periodontics for oral prophylaxis. There was no contributory medical history. On clinical examination, periodontal pockets were seen in the region of 33 to 43 and 21 to 23 with depth of 5-6 mm. Phase 1 therapy was carried out that included full mouth ultrasonic scaling and root planing in the region where pockets were present. After 2 weeks, patient was recalled for follow up which showed persistent periodontal pocket in the region of 33 to 43. Periodontal flap surgery was planned for the same region. After flap reflection and thorough debridement, closure was carried out using LTB in 33 to 43 region.



Fig.10: ICG dye application



Fig.11: Egg white application



Fig.12: Laser irradiation



Fig.13: 7th day postoperative view

Discussion

Periodontal tissue presents as a surgical wound immediately following any periodontal surgery. In an order to repair this wound, cascade of cellular as well as molecular events is initiated.⁷ Apart from thorough debridement of the site, proper closure and stabilization of wound margins in the desired position are critical factors that influence the final surgical outcome. Numerous unique methods and materials have been proposed to achieve successful wound closure in various surgical disciplines.² During the postoperative phase, as the oral cavity is an aqueous environment and the formation of biofilm takes place inevitably, bacterial colonization may jeopardize uneventful healing.

Laser welding is not a new concept to the field of medicine and have been tried for the nerve and vessel repair, closure of skin incisions since a long time; But all these studies are experimental and primarily conducted in animals or samples of animal origin (aorta, sciatic nerve, mucosa).^{6,8,10} In relation to oral cavity, Mirdan¹¹ used laser welding for closure of palatal incisions in rabbits. Author concluded that laser welded tissues showed a comparable picture with the sutured ones at ten days and two weeks postoperatively, there were indications of fastened healing process; that was characterized by the flatter re-epithelialization without the cleft-like formation that was observed in the sutured incisions for the same period. This finding could be attributed to the well approximated edges of the incisions that were welded by laser when compared with sutured ones. Another study was done by Rasca et al³ in which laser welding was carried out in porcine jaw model. They also concluded that LTW done using indocyanine green was a promising technique in gingival repair.

The main problem with conventional LTW is insufficient bond production at low temperature and collateral thermal damage at higher temperature. Apart from this, tensile strength achieved only with LTW was sometimes inferior than that of conventional suturing. So, in order to overcome these pitfalls, Menovsky and Beek⁶ used human albumin solution, egg white, fibrinogen fibrin glue or red blood cells as a solder material for nerve repair using LTW. They concluded that tensile strength obtained by human albumin solution and egg white was comparable with the final strength obtained by conventional suturing. Another study done by Mistry et al in which 25% and 50% albumin solution was used as a solder to repair mucosal incisions in bovine model showed that values of breaking load were

higher in 50% albumin solution group and the thermal damage was restricted to upper layers; the spread was seen more laterally.

Gowda and Kumar⁵ conducted LTB in patients undergoing periodontal flap surgery. In this study, indocyanine green dye was used to increase the absorption of light and commercially available human albumin (Alburel). The study showed that LTB was effective in achieving impeccable, scar-less wound closure with no morbid complications associated. The reason behind using any photosensitive dye (Eg, Indocyanine green) is maximum absorption of laser light and reduction in thermal damage to the surrounding tissue as well as its antibacterial activity. The solder helps to increase the surface area of the bond and tensile strength of the bond established. In our study, egg white was used as an alternative to human albumin solution for reasons- 1. It contains abundant amount of albumin. 2. Its cost effectiveness as compared to human albumin, hence 3. It can be applied in ample amount.

In both case reports, comparisons between two techniques showed qualitatively better outcomes with LASER welding. In our case report, we assessed wound healing using Landry's healing index and it was very good for all the treated sites. As it is already proven, laser fastens the wound healing, there are less postoperative complications and hence better patient compliance

Limitations

More number of studies and specially, randomized controlled trials are required to examine the efficacy of egg albumin as a solder as compared to human albumin solution. Major drawback is egg albumin cannot be used in patients with known allergy. Also, in order to reduced collateral thermal tissue damage, temperature controlling system.

Conclusion

Within limitations of this case report, it can be said that LTB is a promising technique which can be advocated as an alternative to conventional suturing. Although the research on LTB is still at a primary level, it has provided an optimum information about the safety, feasibility of the technique and base for conducting clinical studies, especially randomized controlled trials. Future research should be directed towards development of an appropriate LTB apparatus with a temperature-controlled laser light.

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