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Case Report

# Technical Note on Vestibuloplasty Around Dental Implants Using Er:YAG Laser-Assisted Periosteal Fenestration (LA-PF)

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**Abstract:** Various vestibuloplasty techniques have been reported to increase the attached mucosa (AM) and vestibular depth around dental implants. However, these surgical methods have disadvantages, such as limitations in manipulation, necessity of suturing, postoperative discomfort, swelling, and pain. This study aimed to evaluate the efficacy of laser-assisted periosteal fenestration (LA-PF) in treating a patient with a shallow vestibule and insufficient AM around dental implants. The LA-PF technique was performed using an Er:YAG laser. First, a partial-thickness apically positioned flap (APF) was performed. Horizontal periosteal fenestration was performed using an Er:YAG laser to expose the bones. Periosteal suturing was not required. After 12 months, sufficient AM and deepened vestibule were obtained and maintained. Thus, the LA-PF technique may be a simple and predictable treatment modality for vestibuloplasty around dental implants.

**Keywords:** apically positioned flap; Er:YAG Laser; free gingival graft; periosteal fenestration; vestibuloplasty

## 1. Introduction

The discussion on the need for attached mucosa (AM) for peri-implant health and long-term stability is still on-going [1]. However, recent studies have shown that a sufficient amount of AM around dental implants is associated with less plaque accumulation and a lower incidence of peri-implantitis [2]. Thus, creating an immobile AM of at least 2 mm is important for the long-term peri-implant health [3].

Khoury et al. reported that an apically positioned flap (APF) combined with a free gingival graft (FGG) is the best treatment modality to increase the AM [4]. However, FGG requires the formation of a donor site, which increases the patient's discomfort, increases the surgical time and the risk of postoperative complications [5]. APF is a relatively simple technique, but has the disadvantage of a high risk of relapse [6].

To compensate for these disadvantages, we introduced modified periosteal fenestration (mPF) in a previous study to form sufficient AM and vestibule around the implant [7]. Unlike FGG, mPF did not form a donor site, but instead compensated for the high recurrence tendency of APF through periosteal fenestration. However, a skilled technique for periosteal suturing is required. Subsequently, we introduced simplified periosteal fenestration (sPF), which can make periosteal suture easier, in a follow-up study [8]. However, since both techniques perform surgery using a scalpel, it is difficult to secure the field of vision due to bleeding during the partial-thickness flap. Manipulation or periosteal suturing may not be possible in the posterior molar region.

In this case report, we describe the technical aspects of laser-assisted periosteal fenestration (LA-PF) using an Er:YAG laser, making it easier to form AM around the dental implant without forming a donor site or periosteal suturing.

## 2. Case Report

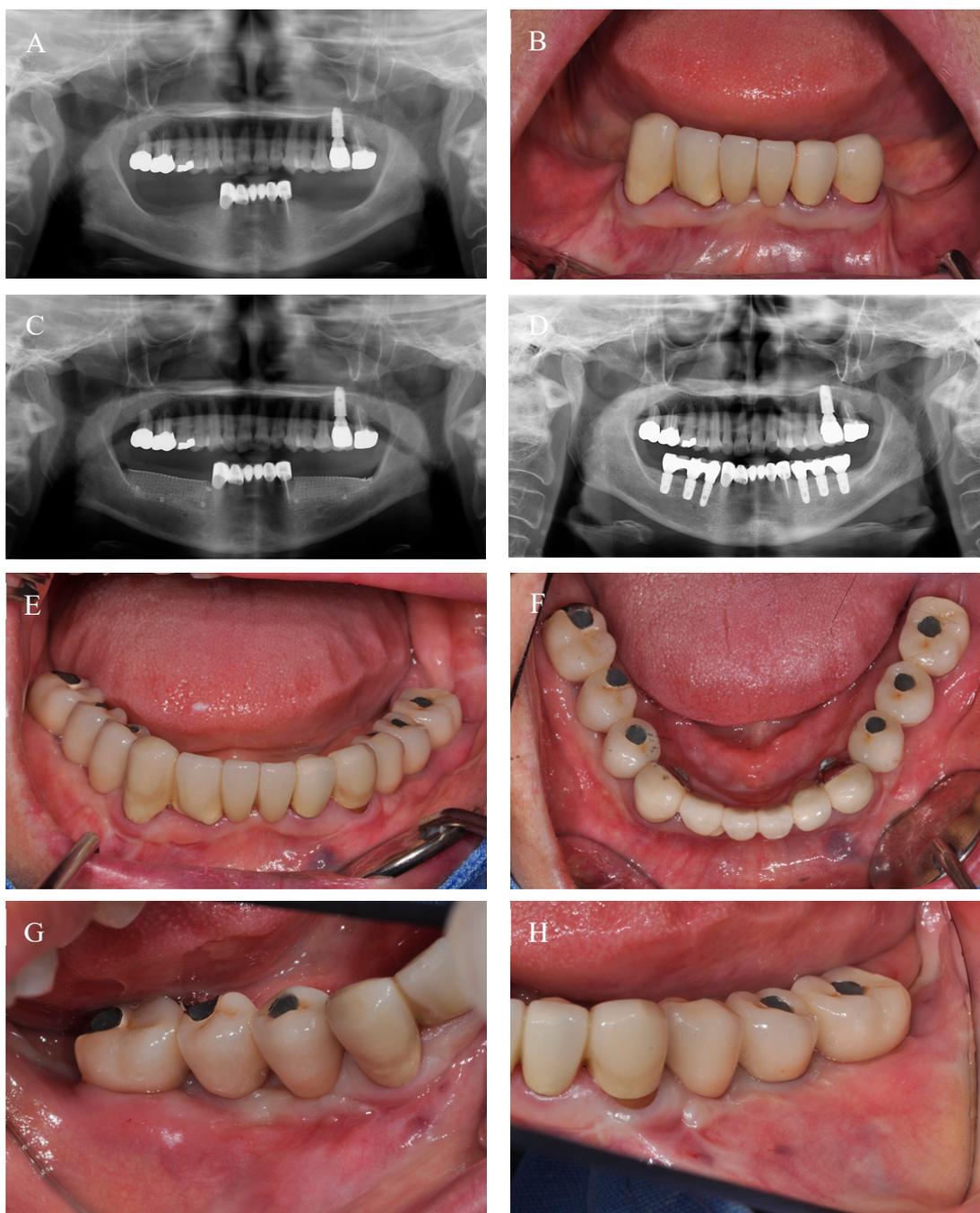
### 2.1. Surgical procedures of Er:YAG laser-assisted periosteal fenestration (LA-PF)

The LA-PF technique was performed using an Er:YAG laser (LiteTouch™, Shinhung Co., Seoul, Korea), a contact/non-contact hand piece, pulse energy of 200 mJ, and frequency of 18 Hz with water spray. First, a partial-thickness flap was created from 2 to 3 mm below the peri-implant soft tissue margin using the Er:YAG laser under local anesthesia. This process proceeds to the depth at which the vestibule is formed. The accessibility was good when using a hand-held laser. Due to hemostasis of the laser, bleeding was minimal, and periosteal sutures were not required. Subsequently, periosteal fenestration was performed. A band-shaped alveolar bone with a width of 2 mm was exposed at the apical area of the split lower flap using an Er:YAG laser. An absorbable periodontal pack (Reso-Pac®; Hager & Werken GmbH & Co. KG, Duisburg, Germany) was used to protect the wound. Postoperative analgesia (Aceclofenac 100 mg, Dona-A ST, Seoul, Korea) was administered twice daily for a week.

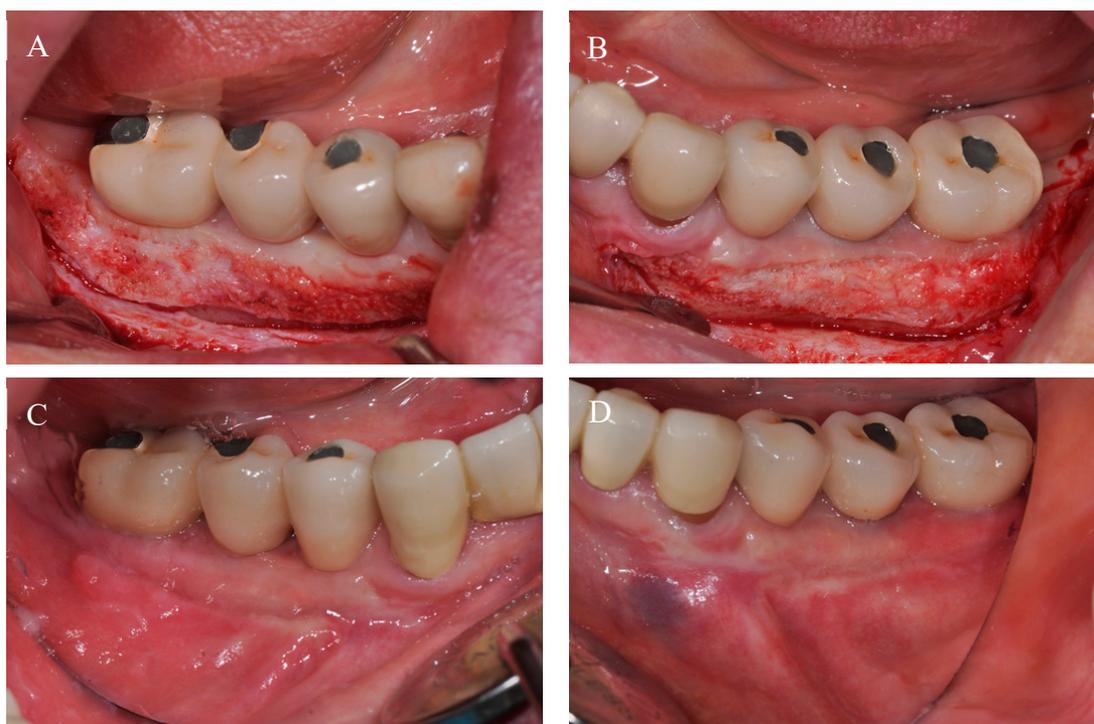
### 2.2. Case

A 65-year-old female patient visited the dental hospital with the desire to place implants in the posterior teeth on both sides of the mandible. This patient had used dentures for the past 20 years. As a result, the ridges of the lower posterior teeth on both sides atrophied, and the width of the keratinized gingiva narrowed. For implant placement, vertical and horizontal guided bone regeneration was first performed using an allograft (Do Bone®, CGBio, Seongnam, Korea) and Titanium-mesh (Ti-mesh). After 5 months, the Ti-mesh was removed and the implants were placed. After prosthetic fabrication was completed, sufficient AM was not observed on the buccal side of the implants. In particular, the vestibule became shallow toward the posterior molars. This might be the result of vertical guided bone regeneration along with insufficient keratinized gingiva (Figure 1).

Therefore, the LA-PF technique described above was used to increase the depth of the AM and the vestibule. An APF of approximately 6 mm was observed immediately after surgery. At 12 months postoperatively, a favorable AM and vestibular depth of approximately 4 mm were maintained in most implant sites (Figure 2).



**Figure 1.** (A) Panoramic radiograph and (B) clinical condition at the initial examination. (C) Panoramic radiograph after vertical ridge augmentation. (D) Panoramic radiograph after the final prosthesis. (E) Frontal view and (F) occlusal view after the final prosthesis. Peri-implant soft tissue condition of (G) right molar area and (H) left molar area after the final prosthesis.



**Figure 2.** (A,B) Buccal view immediately after performing laser-assisted periosteal penetration (LA-PF). (C,D) Clinical view at 12 months after LA-PF. Increased AM was observed around the implants.

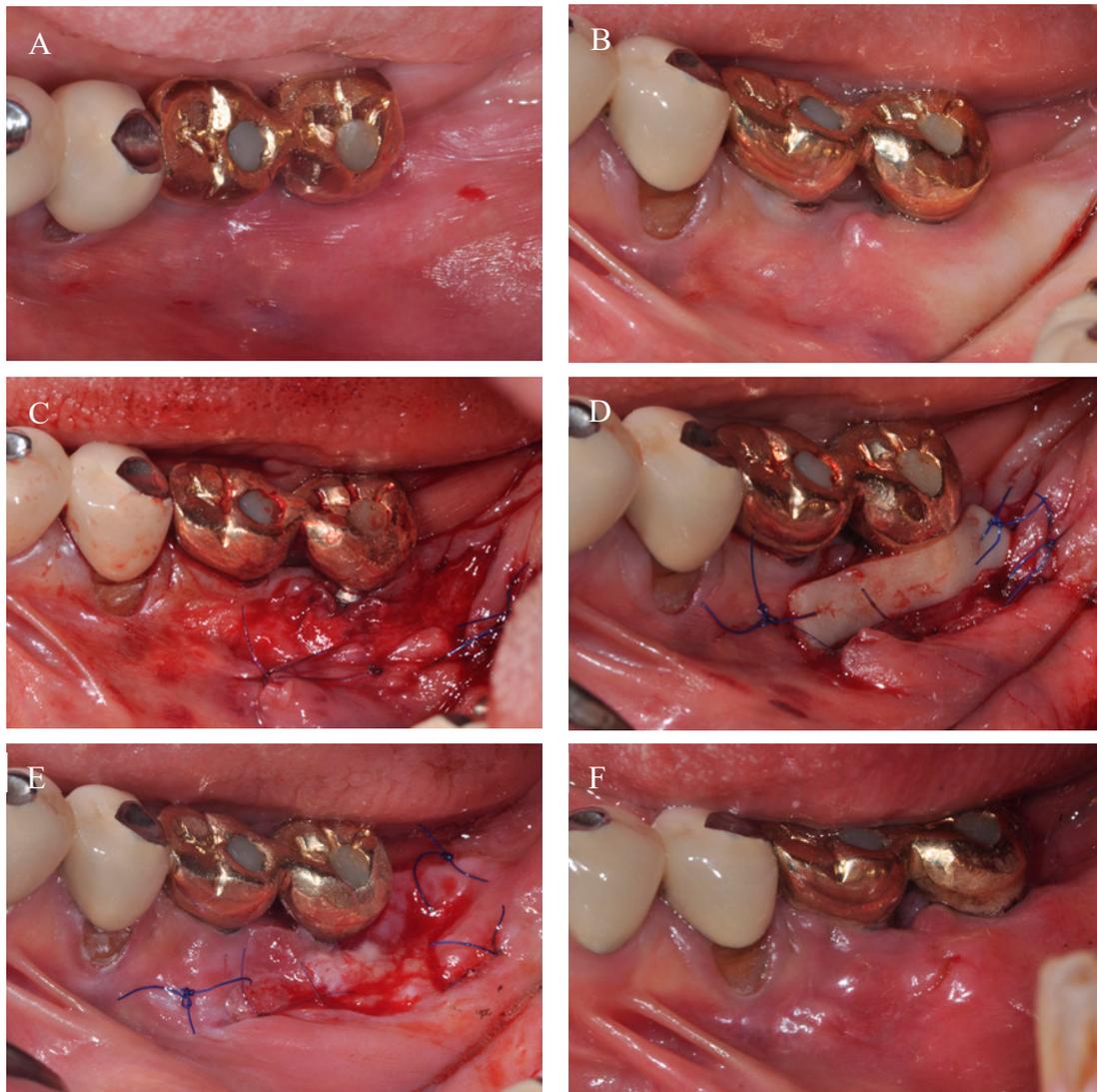
### 3. Discussion

In this case, we determined whether the LA-PF could effectively form the AM and vestibule around the implant. The LA-PF technique was able to acquire and maintain 4 mm of AM at 12 months of follow-up, similar to conventional surgical techniques. Although there is still controversy about whether the AM around the implant is related to the health of peri-implant tissue, recent studies have shown that implants with an AM of less than 2 mm could lead to increased patient discomfort along with loss of marginal bone and increased bleeding during probing [9]. In particular, erratic maintenance compliers reported that at least 2 mm of AM acts as a protective factor against peri-implantitis [10]. Therefore, the LA-PF technique can be a procedure that can secure the health of the peri-implant soft tissue by obtaining an AM of 4 mm or more.

APF combined with FGG is the most effective way to acquire AM [4,10]. However, our previous study showed that periosteal fenestration can replace FGG as an effective vestibuloplasty technique [11]. It compared the changes in AM width 1 year after vestibuloplasty using APF, FGG, and mPF around mandibular posterior implants. All three procedures required approximately 6 mm of AM immediately after the surgery. However, there was a tendency to recur, of approximately 2 mm for APF and 4 mm for FGG and mPF, 1 year after surgery. Periosteal fenestration has a lower tendency to recur than APF alone because the alveolar bone exposed after periosteal fenestration undergoes secondary healing as a band of scar tissue. Kon et al. explained this clinically and histologically through animal experiments, and said that collagen fibrils were embedded in the site where the exposed alveolar bone was resorbed to form a scar tissue band [12]. This band of scar tissue acts as a physical barrier that reduces the tendency of the repositioned buccal muscle to return to its original position. Thus, periosteal fenestration is less prone to recurrence than APF, and can attain AM as predictable as FGG.

FGG requires a high level of surgical skill for the process of forming recipient and donor sites. In other words, when fixation of the free gingiva is insufficient or excessive mobile tissue is present in the recipient site, the prognosis of FGG becomes poor (Figure 3). In contrast, in the case of LA-PF, in addition to the advantage of not requiring a donor site, it does not require a high level of

surgical skill because it does not require proper recipient site formation and graft stability, which are required for the success of FGG (Figure 4).



**Figure 3.** A 65-year-old woman with deficient attached mucosa (AM) in #36, 37 implants (A) Occlusal view and (B) buccal view at the initial examination. (C) Buccal view immediately after performing partial-thickness apically positioned flap (APF). (D) Buccal view immediately after free gingival graft (FGG). (E) Healing condition at 1 week post-operatively. (F) Clinical view of #36, 37 implants at 4.5 months after FGG. Postoperative relapse was observed.



**Figure 4.** The laser-assisted periosteal fenestration (LA-PF) technique was performed in the same patient as in figure 3. (A) Occlusal view and (B) buccal view at the initial examination. (C) Occlusal view and (D) buccal view immediately after performing LA-PF. (E) Healing condition at 1 week postoperatively. (F) Clinical view at 2 months postoperatively. (G) Clinical view of #36, 37 implants at 1 year after LA-PF. (H) Clinical view of #36, 37 implants at 3 years after LA-PF. Increased attached mucosa remained stable for 3 years postoperatively.

Conventional surgical vestibuloplasty techniques cause bleeding, limited manipulation, postoperative pain, and swelling, thereby reducing patient satisfaction [13]. On the other hand, if a laser is used, the field of vision is secured due to the hemostatic effect, and the treatment time can be

shortened by eliminating the need for periosteal suturing [14]. Among which the Er:YAG laser has better absorption in water than the CO<sub>2</sub> laser or Nd:YAG laser. Thermal mechanical tissue ablation can be performed in a very narrow layer [15]. Therefore, a more precise incision is possible, and thermal damage to adjacent tissues can be minimized. The carbonized tissue layer is thinner than that from other lasers, and some bleeding may be observed; however, the healing process is faster, which can reduce pain or discomfort after surgery. Compared to the diode laser, less thermal damage was reported, and in particular, less osteonecrosis was observed with the Er:YAG laser [16]. Therefore, the Er:YAG laser is recommended over the diode laser in the LA-PF technique, which requires periosteal fenestration to expose the alveolar bone.

#### 4. Conclusions

In this case report, we suggest that LA-PF could be a simple and predictable treatment modality for increasing insufficient AM around implants. In particular, the necessity of periosteal suturing, which is required by conventional techniques, is eliminated, making it easier for clinicians to apply the technique. In addition, it is expected that the Er:YAG laser can be used to reduce pain and discomfort, leading to patient compliance with treatment. However, because the number of cases is limited, large-scale, long-term, and in-depth studies on LA-PF are considered necessary in the future.

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**Informed Consent Statement:** Informed consent was obtained from the subject involved in the study.

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**Conflicts of Interest:** The authors declare no conflicts of interest.

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