LANAP and LAPIP - A Prodigal Elixir to the Periodontitis and Peri-implantitis Malady

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Abstract: The goal of reconstructive periodontal therapy is the regeneration of lost periodontium. Regeneration in a true sense refers to the formation of new bone, cementum, and periodontal ligament. New attachment means the embedding of new PDL fibers into new cementum, & attachment of epithelium to a tooth previously denuded by disease. Advances in periodontal therapy leads to the formation of new procedures that are less invasive, less painful, more effective and causing minimal discomfort to the patient. LANAP is one such procedure that will lead to true regeneration as well as new attachment. LAPIP is a recent modification of lanap, can be used for treating peri-implantitis.

Keywords: LANAP, LANAP protocol, LAPIP, Regeneration, New attachment, Lasers.

INTRODUCTION

The paradigm of periodontal treatment is changing from resective to regenerative and reconstructive procedures[1]. The primary goal of periodontal therapy is the regeneration of the tooth's supporting structures and tissues[2]. Periodontal regeneration is defined as the reproduction or reconstitution of a lost or injured part in order to restore the form and function of the lost structure. This should be distinguished from the term “new attachment,” which describes the formation of new cementum by inserting collagen fibers on a root surface devoid of periodontal ligament tissue but does not necessarily mean complete regeneration of the periodontium[3].

The periodontium is a complex organ made up of epithelial tissue and soft and mineralized connective tissues, including the gingiva, periodontal ligament, cementum, and alveolar bone. Because of the distinct anatomy and composition of the periodontium, interaction between the epithelium and hard and soft connective tissues is necessary for periodontal wound healing, which is a more complicated process than general soft tissue healing[4]. Thus, periodontal wound healing is a distinct and complex process that necessitates the coordinated response of four distinct soft and hard tissues: gingival connective tissue, periodontal ligament, cementum, and bone. Studies on the healing of periodontal wounds generally show that traditional periodontal therapy most frequently leads to collagenous scar tissue repair, which is accompanied by the apical migration of gingival epithelium between the root surface and the gingival connective tissue. This healing process does not fully restore the form or function of the lost structures, so it cannot be considered regeneration[5].

There are various treatment approaches that can lead to the regeneration of alveolar bone, cementum, and periodontal ligament in teeth affected by periodontitis, as well as the formation of new connective tissue attachment and most of them are associated with surgically implanted devices or materials. Many physicians and patients are reluctant to use surgical therapeutic approaches due to the real and expected side effects (such as post-operative pain and root exposure)[6].

'Pain free' and 'simple procedure' are two of the most appealing phrases to patients who would otherwise refuse any dental treatment. Minimally invasive dental therapy could satisfy the demands of such patients. The LANAP (Laser Assisted New Attachment Procedure) is one of these minimally invasive surgical treatment options that can result in periodontal regeneration and cementum-mediated connective tissue attachment[7].

HISTORY OF LANAP

• In 1976, Yukna et al described the ENAP (Excisional New Attachment Procedure) which is performed with a knife [8].
In 1998, Robert H. Gregg and Del McCarthy developed a unique LANAP (LASER-assisted new attachment procedure) protocol [9,10]. The LANAP protocol was initially known as Laser-ENAP before being renamed laser periodontal therapy (LPT) to avoid confusion with scalpel ENAP by the FDA [11,12]. LANAP received US FDA clearance in 2004.

LASER SYSTEM FOR THE LANAP PROTOCOL

The LANAP protocol used a free-running (FR) pulsed Nd:YAG laser (PerioLase MVP-7 [Millennium Dental Technologies]). It has the following features [13]:

- The PerioLase MVP-7 is a 6-watt, free-running pulsed Nd:YAG laser with a wavelength of 1064 nm.
- It has seven adjustable pulse durations from 100 to 650 μsec.
- Pulses can have a recurrence frequency of 10–50 Hz and an amplitude of 30–400 mJ. The average power range for these LASER settings is 0.30–6 W.
- The TruFlex™ fiberoptic handpiece and pliable cannula allow for access to distal molars.
- LASER energy is emitted from a 320 μm optical fiber in contact mode.

LASER SETTINGS/PARAMETERS FOR THE LANAP PROTOCOL

The following laser parameters were used for the LANAP protocol [14,15]:

- For the first application: 3–4 watts of power, 100–150 μsec pulse duration, and 20 Hz frequency.
- For the second application: 3–4 watts of power, 635–650 μsec pulse duration, and 20 Hz frequency.
- The approximate lasing time used was one minute per tooth.
- Short pulse duration is used for laser ablation (100–150 μsec), and long pulse duration is used for hemostasis (635–650 μsec).

STEPS OF LANAP PROTOCOL

The LANAP protocol has a simple concept. LANAP aims to create a periodontal environment that promotes self-regeneration of lost periodontium due to periodontal disease. The procedure combines FR-pulsed Nd:YAG LASER with a precise, research-tested protocol. Typically, the procedure is done in one or two non-adjacent quadrants. LANAP is recommended for patients with pocket depth (PD) ≥4 mm who require standard periodontal treatment [16].

The steps that make up the LANAP protocol are as follows [17]:

Step 1 (Bone sounding)

There is no need of initial periodontal therapy (scaling or Root planing) prior to LANAP procedure. After profound local anaesthesia, bone sounding with periodontal probe will be done to determine the probing depth and osseous morphology.

Step 2 (Laser ablation)

In this step, the laser is used for the first time. The initial laser pass, known as "Laser Troughing," is achieved using a short pulse (3W, 150μs pulse duration) at 20 Hz. A thin 0.3 to 0.4 μ laser fiber allows for easy access to deep periodontal pockets, eliminating the need for surgical flap elevation. The laser tip is placed parallel to the root surface and continuously moved in a coronal-apical direction until it reaches the base of the pocket. This step causes selective photo thermolysis of the diseased epithelium and bactericidal effects on pigmented periodontal pathogens like P. gingivalis.

Step 3 (Ultrasonic scaling and root planing)

The calculus present on the root surface is removed using the piezoelectric ultrasonic scalers. After that, accretions on the root surface are removed using small curettes and root files. Aggressive root planing is avoided.
Step 4 (Bone modification)

In this step, bleeding is induced by blunt dissection into the alveolar bone or intra marrow penetration. This causes the **Regional Acceleratory Phenomenon (RAP)** and the release of stem cells and growth factors from the cancellous bone and periodontal ligament, thereby enhancing periodontal regeneration.

Step 5 (Laser haemostasis)

This step involves the use of the laser for the second time to complete the debridement and produce hemostasis. The laser parameters (4W, 635-µs pulse duration, 20 Hz) are adjusted to create a soft gelatinous thermal fibrin clot that closes the mini-flap and disinfects the site. The fibrin clot remains stable for about 14 days. The thick gelatinous thermal fibrin clot seals the sulcus, preventing bacterial infiltration and epithelial growth apically.

Step 6 (Close adaptation)

This step involves compressing the gingival tissues against the root surface to seal the pocket orifice and stabilize the fibrin clot. LASER wounds heal through secondary intention, so close adaptation promotes healing. Surgical glue or sutures are not required.

Step 7 (Occlusal adjustments)

Mobile teeth with more than class II mobility are splinted. Occlusal trauma adjusted. Occlusal adjustments are thought to be a crucial part of the LANAP protocol because they eliminate interferences, reduce trauma, and balance long axis forces.

At the end of the procedure, patients are given LANAP protocol postoperative instructions, including proper diet specifications and oral hygiene instructions, with a strong emphasis on ongoing periodontal maintenance. Patients are recalled every week, one month, and then every three months for periodontal maintenance. Probing is not allowed for the next six to one year in order to give tissues enough time to heal at the cementum-fibre PDL interface. Periodontal probing is only done on the last post-operative visit.

Figure 1: Steps of LANAP protocol: A. Perio probe indicates excessive pocket depth; B. Laser radiation vaporizes bacteria, diseased tissue, pathologic proteins, and alerts the practitioner to the presence of tartar; C. Ultrasonic scaler and special hand instruments are used to remove root surface accretions; D. Bone is modified at time of surgery; E. Laser is used to form a gel-clot containing stem cells from bone and PDL; F. Reattachment of reté ridges to clean root surface, with a stable fibrin clot at the gingival crest to create a ‘closed system’; G. Occlusal trauma adjusted; H. New attachment is regenerated[17]
LANMARK STUDIES OF LANAP (Table 1)

Table 1 : Land mark studies of LANAP

<table>
<thead>
<tr>
<th>Author</th>
<th>Laser used</th>
<th>Number of subjects/sites</th>
<th>Length of study</th>
<th>Summary of author’s conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nevins et al 2014 [7]</td>
<td>Nd: YAG</td>
<td>8/all full mouth quadrant</td>
<td>9 months</td>
<td>LANA produced clinical attachment level gain and probing depth reduction</td>
</tr>
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LANAP AND PERIODONTITIS MICROBIOTA

McCawley in 2018, compared the LANAP surgical protocol to ultrasonic root debridement alone for immediate post-treatment effects on putative bacterial pathogens in deep human periodontal pockets. Red and orange complex bacterial species were culture-negative immediately post-treatment in 85% of LANAP-treated patients, but only 16.7% of patients subjected to ultrasonic root debridement alone [18].

In 2023, Bechir discovered that, in comparison to scaling and root planing alone, LANAP resulted to a higher reduction in pocket depth, improved clinical outcomes, and a significant decrease in the quantity of Porphyromonas gingivalis [19].

LANAP AND ENAP

Sameera et al. (2018) compared the clinical efficacy of LANAP and ENAP, as well as measuring blood flow in both procedures using ultrasound Doppler flowmetry.

The authors observed a greater reduction in all the parameters in the LANAP group compared to that of ENAP group. The rate of revascularization was found to be higher in the ENAP group than that of LANAP group [20].

LANAP AND TOOTH RETENTION

After treating stage III and stage IV periodontitis with both LANAP and conventional surgical methods, Tilt (2012) conducted a meticulous comparison of post-operative assessments and concluded that, despite being less invasive, LANAP produces results that are comparable to those of conventional surgical methods in terms of long-term stability and retention of the tooth [21].

Yu in 2023 stated that tooth retention was more favourable among patients with the full mouth LANAP procedure [22].

LANAP AND DIABETES

Long in 2008 stated that the LANAP therapy has been shown to provide new bone growth and stability in patients with type IV chronic periodontitis, reestablish new cementum-mediated periodontal ligament attachment, and induce periodontal regeneration. The patient’s HbA1c levels and periodontal health exhibited marked improvement after LANAP treatment [23].

LANAP AND ORTHODONTIC TREATMENT

According to McCraken’s 2014 study, the combination of the LANAP protocol and orthodontics is a truly innovative concept with very positive outcomes [24].
RECENT ADVANCEMENT OF LANA\textsuperscript{P} (LAPIP)

Peri-implantitis (PI) is a disease of the tissues surrounding dental implants. Peri-implantitis is defined as an inflammatory condition in which implants with varying degrees of bone loss are accompanied by a probing pocket depth (PPD) of at least 4 mm, bleeding on probing (BOP), and purulent discharge upon probing (Roos-Jansaker et al., 2006) [25]. PI occurs in 10\% of implants and in 20\% of patients within 5–10 years after implantation (Mombelli et al., 2012) [26].

An emerging experimental technique for treating PI is the laser-assisted PI protocol (Aoki et al., 2015) [17]. The LAPIP technique is an implant-specific modification of the laser-assisted new attachment protocol (Nevins et al., 2014) [27].

McCarthy (2013) proposed LAPIP, or "Laser-Assisted Peri-Implantitis Procedure," as a modification of LANAP that could be used in diseased implants. The laser removes inflamed pocket tissue, disrupts biofilms, and sterilizes the root/implant surface. Decrease in inflammation and a laser-induced haemostasis further decontaminates the tissue creating a durable blood clot to close the system [13].

The LAPIP protocol has the following steps [17]:

1. Periodontal probing is done for assessing pocket depth.
2. The first LASER application uses the same LASER parameters as the LANAP protocol to vaporize diseased tissues, bacteria, pathological proteins, and titanium corrosion products in soft tissue.
3. Ultrasonic scaler tip is used to remove accretions from the implant surface (calculus and cement).
4. Bone is then modified and de-corticated to release fresh blood, stem cells, and growth factors.
5. Again, using same LASER parameters as LANAP protocol, 2nd LASER application forms a stable gelatinous thermal fibrin clot comprising stem cells and growth factors.
6. "Closed system": Finger pressure is then applied to the coronal soft tissue against the implant surface to achieve adhesion.
7. Occlusal adjustment is done to eliminate/reduce traumatic forces.
8. New attachment.

CLINICAL OUTCOMES WITH LAPIP

McCarthy (2013) showed that outcomes with the LAPIP protocol are significant. Multiple cases depicted re-integration and stabilization of dental implants with surrounding soft tissues and bone growth up to 3–8 implant threads [28].

In 2020, Schwarz and Harris conducted a retrospective cohort study to evaluate the clinical results of 437 dental implants pre-diagnosed with peri-implantitis in 222 consecutive patients who were treated with LAPIP. The PD reduction from 5.4 mm (at baseline) to 3.4 mm (at a median of 7.6 months) was found to be statistically significant. The reduction in clinical signs (BOP and erythema) was also statistically significant [29].

ADVANTAGES OF LANAP AND LAPIP

- Minimally invasive with better patient compliance
- Decreased postoperative pain and morbidity
Less likely to develop hypersensitivity
• Less prone to recession
• Faster healing
• Natural teeth as well as implant both show regeneration of the surrounding tissues.[1]

DISADVANTAGES OF LANAP AND LAPIP

• Despite the positive results in various studies, some studies were not concluded LANAP have better results over conventional periodontal therapy [30,31]. Thus, long term randomized controlled trials are necessary to confirm the efficacy of these techniques.
• The treatment can be expensive.
• If the laser is not used with caution, it can cause serious alveolar tissue damage. According to some research, using lasers in periodontal pockets may harm the surfaces of the roots, damage the alveolar bone nearby, or result in undesired pulpal changes [32].

CONCLUSION

The LANAP and LAPIP protocol is believed to be emerging as a treatment modality in periodontal practice because of its efficacy to promote a true periodontal regeneration. However, LANAP and LAPIP techniques are still in its infancy. These techniques must be further investigated with histologic evaluations for periodontal or peri-implant regeneration with large sample size and also under long term randomized controlled clinical trials for comparing the stability of clinical outcomes to the conventional periodontal therapy.

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