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The periodontal pocket: alternative treatment with Er:YAG LASER and PRF

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The Er:YAG LASER/PRF synergy with the use of optical aids in the microsurgical treatment of periodontal pockets: a therapeutic breakthrough in the treatment of periodontitis.

Introduction

Developments in our knowledge in the fields of biology, microbiology, tissue engineering (Sanz 2015), and technological progress motivate us today to propose new therapeutic approaches and new surgical protocols to treat periodontal diseases.

Periodontal diseases are chronic inflammatory pathologies resulting from an imbalance between the oral microbial flora and the patient's defense systems (Kornmann 1997, Kulkami 2014). They are characterized by the presence of periodontal pockets which are actually open wounds in a septic environment. The treatment of periodontitis consists of managing the risk factors of the imbalance and, in particular, of ensuring the disappearance of its chronic inflammatory wounds which are the periodontal pockets (Cekici 2014). The fundamental therapeutic concept for treating these wounds is simple: they must be cleaned so that they heal.

A mini-invasive, Er-Yag-LASER-assisted protocol is proposed here, as a supplement to conventional instrumentation, to transform these chronic inflammatory wounds into clean surgical wounds. PRF will be used to protect these wounds and stimulate healing.

The periodontal pocket: a chronic inflammatory wound

The pockets represent the progression front of the pathology. They are the site of an aggressive and complex microbial proliferation which induces a cascade of inflammatory reactions leading to the tissue destruction of the periodontium (Andrew D 2013). All of these events occur in a confined space relatively inaccessible to oral hygiene and produce an inflammatory infiltrate within the periodontal pocket.

An acquired inflammatory reaction turns chronic because the presence of pathogenic agents is permanent and continually renewed in this open space. The inflammatory infiltrate is located in the internal layer of the gingival margin of the periodontal pocket. The epithelium of the pocket is completely destroyed by the proteolytic enzymes induced by the inflammatory reaction and it allows the microbiota to pass which penetrates the tissues (and even beyond them), representing a chronic inflammatory infiltrate (Hannu Larjava 2012).

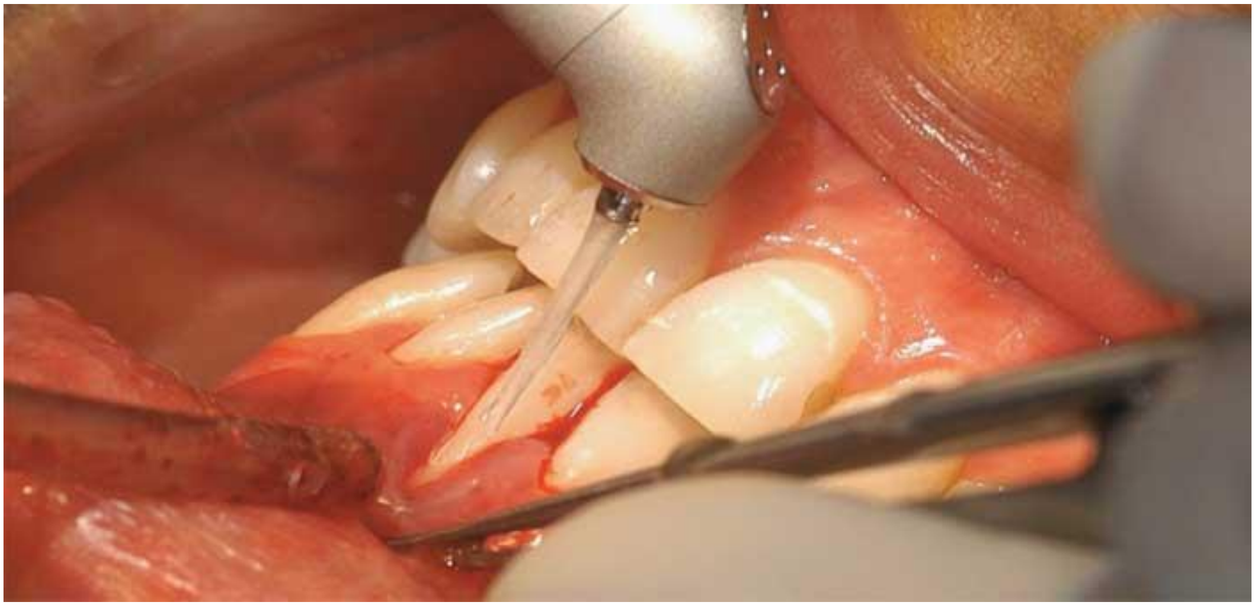
To stop the progression of this inflammatory state, the infiltrate must be specifically eliminated and the periodontal pocket must be cleaned (Maciejczyck 2016, Amar 2017), thus the chronic inflammatory wound becomes a clean surgical wound which will be able to heal (Kaner 2017). The pathogenic agents and the local risk factors are eliminated. The acquired immune reaction resulting from the persistence of pathogenic agents will disappear and will be able to leave room for a healing and tissue reconstruction process. In this simple therapeutic concept, the natural healing will be stimulated by a tissue engineering procedure consisting of protecting the clean periodontal wounds using PRF pellets.

To maintain and optimize the healing potential of the periodontium which is considerable, the surrounding vascular and tissue structures should be preserved. It is for this reason that mini-invasive periodontal cleaning protocols are favored for the cleaning of the periodontal pockets.

The Er:YAG LASER: a microsurgical cleaning tool

There are numerous protocols for cleaning the deep periodontium: PPT Takei 1985, ITM Murphy 1996, MPPT Cortellini 1995, SPPT Cortellini 1995, SFA, Trombelli 2007 & 2008. The protocol proposed here is becoming part of the family of mini-invasive surgical protocols (Baudot F 2014). It is performed entirely with optical aids of a minimum of 3.5x. The hard wall of the periodontal pocket is traditionally cleaned using ultrasound with micro-inserts and under visual control.

The Er:YAG LASER is used to eliminate the inflammatory infiltrate on the internal part of the marginal gingiva and on the bone. It also allows fine decontamination of the radicular surface after the elimination of tartar concretions using ultrasound (Schwarz 2003).



The Er:YAG LASER, a microsurgical tool used for its selective tissue ablation properties to eliminate the inflammatory infiltrate in the deep cleaning of the periodontium.

The Er:YAG wavelength (2940nm) has the principal characteristic of being significantly absorbed by water (Colluzzi 2008). This physical property gives it mini-invasive clinical effects. The energy delivered by the beam onto the targeted tissues is massively absorbed by the first cellular layers which are significantly hydrated in human tissues. This irradiation causes vaporization of the first tissue layers. The Er:YAG LASER acts on the surface through tissue microablation. Since the energy is massively absorbed at the surface, there is no transmission of this energy at deeper levels, thus the risks of increased temperatures in the neighboring tissue structures are almost zero. The thermal alteration layer from Er:YAG radiation is between 5-50 microns (Aoki 2015).

The impact of the Er:YAG beam with matter generates a shock wave. This is the second clinical effect of the Er:YAG LASER: the photo-acoustic effect. Generated in a confined space (the periodontal pocket), this shock wave causes intense agitation of the irrigation solutions and contributes to the destabilization of the biofilms and flushing of the cleaned space (De Moor 2009 2010). This photo-acoustic effect takes place in the 3 dimensions of the space being treated and in the zones which are completely inaccessible to conventional instrumentation, such as, for example, root furcations or deep angular pockets. The Er:YAG LASER reveals its full potential where conventional instrumentation reaches its limits.

The Er:YAG LASER constitutes a key element in the microsurgical cleaning protocol proposed here. It acts selectively on the various tissues of the periodontal pocket. There is in fact a water load gradient within the different tissues treated. The selective aspect of the Er:YAG LASER lies in the fact that the beam will primarily eliminate the most hydrated tissues and will do so with micrometric precision. Thus, thanks to the appropriate settings (Baudot F 2019) of the LASER energy beam, the inflammatory tissues and the biofilms will be destroyed while leaving the healthy and less hydrated tissues (gingiva, ligament, bone and dental structures) intact.

Description of the Er:YAG LASER-assisted microsurgical cleaning protocol

The Er:YAG LASER is not a therapy on its own. It is a microsurgical tool used as a supplement to conventional instrumentation to optimize scaling and root planning in the cleaning of the deep periodontium (Baudot F 2014). Its use in this protocol allows us to have a flapless surgical intervention. The protocol proposed here is based on the approach which Yukna already described in 1976.

The Er:YAG LASER is used to descend layer by layer via tissue microablation along the internal wall of the gingival pocket in order to selectively remove the inflammatory infiltrate. It uses the natural pathway created by the pathology. No healthy tissue is detached or removed. This process involves cleaning the wound under visual control through a space of about 1mm throughout the full depth of the pocket and to the bone. Once the inflammatory tissues have been removed, the visual access to the tartar is improved and it can be removed conventionally.

The LASER is once again used at the end of the protocol to decontaminate the root surface and flush the periodontal pocket. The study of (Komatsu 2012) clearly demonstrated that the Er:YAG LASER, compared to the use of conventional curettes, allowed postoperative bacteremia to be significantly reduced. The bactericidal effects of the Er:YAG LASER (Aoki 2015) allow one to go further than conventional instrumentation in the cleaning of periodontal pockets.

PRF: Protection of the wound and stimulation of healing

Periodontal wounds cleaned according to the Er:YAG-LASER-assisted protocol will be protected by pellets of blood plasma. PRF will constitute a protective barrier for the periodontal pocket and stimulate its healing. (Zhan 2016). The collagen present in the PRF will serve as a matrix for the cellular bridging necessary for the tissue reconstruction process (Dohan 2006). The plasma will also protect the wound from microbial invasion through “closure” which it ensures and the concentration of the immunity it contains.

The high platelet concentration in the PRF pellet will improve the coagulation mechanisms, thus contributing to the stabilization of the blood clot which is the first fundamental step in proper healing. The serum from the pellet will provide chemotactic factors, growth factors, stem cells, and all of the immune cells which will contribute to and stimulate the healing process (Antua 2013, Yu 2017).

PRF will be used alone or added to an absorbable filling material after deep cleaning of the periodontal pockets. In the protocol proposed here, the plasma pellets are not compressed in a membrane ex vivo. They are cut and stored in a pellet to be calibrated to the space to be protected and are compressed in vivo in the periodontal pocket to fill it.

The plasma pellets are cut into pieces calibrated to the periodontal pockets to be filled. They will be compressed in vivo. Mini-invasive treatment of the periodontal pockets up to 8-9 mm and filling with autogenic plasma inserted in the space cleaned with the Er:YAG LASER

Immediate postoperative clinical view of the small pellets inserted in the pockets.

The recommendations are fairly specific.

- PRF is used alone in pockets measuring 3 to 5 mm and without any angular lesions.
- PRF + filling material in pockets greater than 6 mm, or in angular and crateriform lesions (photos)

For cases involving filling, the material used is a bioglass which demonstrates perfect adaptation to this type of protocol. This material, which is very ergonomic in its surgical handling, has the characteristic of being synthetic and absorbable, rather slowly to accompany the natural bone remodeling. When absorbed, it releases bacteriostatic components which thus limit bacterial contamination. The material is mixed with whole plasma pellets (not compressed in a membrane) which are chiseled in a bowl.

The mixture is packed into the pockets for filling, taking care to fill the entire space without excessive pressure on the material. Once filled, the pocket is protected at the surface by a pellet of plasma alone to ensure closure and cellular bridging at the surface.

Mixture of PRF/bioglass; the coagulum formed is very ergonomic to handle / Clinical and radiographic views of a PRF/bioglass filling

Postoperatively, the patient is advised not to perform mouthwashing to avoid destabilizing the plasmas and to allow the natural healing process to proceed. It is not necessary to administer significant amounts of antiseptics because the "the concentrated immunity" present in the plasma ensures the antimicrobial protection of the initial stages of healing. The tissue reconstruction which is going to take place will help create a protective barrier effect.

In this protocol, patients are reevaluated 2 months postoperatively. At this stage, the disappearance of more than 80% of pockets measuring 4mm or greater was noted. Healing continues for 6 to 8 months (Baudot F 2014). It is accompanied by a program of strict periodontal maintenance which is often assisted by the Er:YAG LASER during which the residual pockets close up once again.

In this mini-invasive approach which allows pockets up to 8-9mm to be treated, it is thus possible to reduce the need for an intervention with a surgical flap on the deep periodontium by 2-3%.

Conclusion

The synergy between the Er:YAG LASER used with optical aids and the application of PRF for the treatment of chronic inflammatory wounds which are the periodontal pockets is the result of technology and better knowledge regarding microbiology and tissue engineering. This progress allows us to push the boundaries imposed on us by conventional protocols.

The operative protocol is simplified and optimized to be accessible to a greater number of therapists.

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