Laser and Peri-Implantitis

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The use of dental implants as an alternative to tooth loss has been the preferred, scientifically approved treatment for many years.[1]

The use of implants in the treatment of single, sectoral or total tooth loss allows patients to regain complete dentition.[1]

The replacement of teeth by implants may have simply a functional aim such as to restore the ability to chew in totally edentulous patients by inserting an implant-supported or permanently attached overdenture.

In the anterior sectors, the implants must respect aesthetic objectives to harmonize the peri-implant tissues and the cosmetic elements. The implants can replace the teeth successfully but, as for natural teeth, the long-term durability of the implant-based restorations is a problem.

Do implants behave differently from teeth? Are they susceptible to the periodontal diseases?[2] Is the implant prognosis better than the dental prognosis?[3]

The current data on this subject unfortunately show that the idea of an implant without pathology needs to be reexamined.[4] The peri-implant infectious pathology is a real and new entity. We have to reconsider our position on the macro and micro-textured surface finishes[5-6] enhancing the osteointegration and guaranteeing long-term reliability for the implant-based restorations.[7]

The implant surface finishes were originally smooth, but have evolved towards macro and micro-textured textures, in order to improve the quality and rapidity of the osteointegration.

However, these surfaces seem very sensitive to infection, facilitating bacterial colonization and reducing the reliability of the long-term implant restorations.[8]

The challenge will be to find the possibility of eliminating the peri-implant bone loss and regenerating the wounded tissues.

Prevalence and different forms of peri-implantitis

As early as 1986, Albrektsson wondered whether it was normal for an implant to lose bone after its first year. We find that the rate of peri-implantitis evolves over time.

The number of implants placed has increased, it is true, but the type of practitioners placing them also.

Originally, only experienced practitioners placed implants but currently with the simplification of the act, we find general practitioners who occasionally pose implants, general practitioners who are confirmed implant placers and implantology specialists.

Our success criteria have changed as well as the actual implants: design, surface finish and type of restoration.

In the results these criteria must be taken into consideration but the same types of implants must also be compared.

The prevalence of peri-implantitis[9] seems to be between 7 and 9%.

"The number of implants placed has increased, it is true, but the type of practitioners placing them also."

We also observe that the peri-implantitis rate evolves over time. The peri-implantitis percentage is higher in total edentulous patients both with overdentures and with permanently attached restorations in comparison with the sector and individual bridges.[10] The results of the studies vary from 15%[11] to 25% or 28%.[12]

The cases of mucositis are comparable to those of gingivitis with the same clinical signs (redness, edema, bleeding, etc.) and the same reversibility. Their prevalence is around 77% at 15 years.

Peri-implantitis, by analogy with periodontitis i.e. loss of attachment and bone loss, has 2 main forms: apical peri-implantitis and peri-implantitis in the strict sense.

They appear in 4 forms:

• Early peri-implantitis, as opposed to lack of osteointegration, characterized by extremely rapid loss of the implant (less than one month after placing) with pain, suppuration and spontaneous expulsion of the implants. This represents approximately 0.5% of the cases.

• Moderate peri-implantitis with bone loss of approximately 3 mm.

• Advanced peri-implantitis, between 1/3 and 1/2 of the height of the implant. This peri-implantitis has a prevalence of between 6 and 9% of implants placed beyond 5 years.

After 10 years, the studies seem to show stabilization of the frequency of bone loss.

What attitude should be adopted towards peri-implantitis?

The origin of peri-implantitis is completely identical to that of periodontal lesions,[13] whether due to a bacterial causative agent made up of plain anaerobic destructive bacteria, red and orange complexes or histopathology of the attachment.[14-15]

At the histological level, the implant attachment system differs from that of the tooth.

It should be emphasized, the absence of periodontal ligament is extraordinarily unfavorable to the immune response in face of attacks. The implant is very fragile and responds badly to the bacterial attacks. The bone, above all the cortical bone, which is little irrigated, is very sensitive to infection and thus to osteolysis.

The periodontal ligament is in fact the tooth's defense system, means of repair (vascularization and in situ progenitor cells), adaptation and absorption of occlusal overloads.[16] Other associated factors, such as hygiene, the presence of sites of periodontal, periapical dental infection, the mucogingival environment,[17] bruxism and general or specific diseases affecting the bone metabolism are aggravating or contributory factors.

Again, any attack in the absence of periodontal ligament repair will lead to direct destruction of the peri-implant bone.

Another factor: tobacco.
Alone or associated with alcoholism, stress,[18-19] it leads to a 30 times higher risk of loss.

Finally, at the level of the actual implant, positioning, design, surface finish, material, bone volume, nearness of root or implants, influence implant survival.[20]

The treatment must therefore take into account the aggravating factors cited above, the level of alveoloclasia but also the type of lesion (vertical or horizontal).

In the case of moderate or early peri-implantitis, the removal of the prosthetic components and the reinsertion associated with filling materials or the use of tissue regeneration membranes give excellent results.[20-21]

In the case of major alveoloclasia two alternatives are to be considered:

- Either the lesions are horizontal: the best treatment seems to be apicalization of the tissues with or without modification of the implant surface exposed to the disease. In the case in the figure, the surface will be ground then polished to improve maintenance treatment effectiveness.
- Or we would intervene to treat the angular bone lesions using the therapeutic arsenal at our disposal to treat dental periodontal lesions: debridement, fillings, tissue regeneration, Emdogain®, etc.

"Even in the case of explantation, even more so when the area is infected, laser treatment is beneficial."

Decontamination of the titanium surface remains a major problem in this type of surgery. How can it be treated? Above all, in no case may the properties be modified.[22]

Non-surgical treatments appear to be inappropriate and ineffective.[23-24-25] The use of antiseptics (Chlorhexidine, Hexetidine, H_2O_2, etc.)[26-27] has no effect on bone repair both without surgery and during surgery.

Our treatment strategy must above all consist in modifying the local anatomy, facilitating the cleaning, removing the infected tissues and treating the implant surface.[28]

In presence of suprabony lesions, the suppression of the macroporosities and microporosities has a positive effect for the healing and maintenance of the surfaces exposed to the disease and contaminated.

In the additive or reconstructive surgical techniques however, the modification of the implant surface is of absolutely no use and is not indicated. Therefore, extreme prudence must be adopted when removing pathological tissues, using specific curettes or avoiding touching of the implant surface.

Sanding or polishing techniques are harmful because they irreversibly degrade the qualities of the implant surface and consequently the possibilities of repair.

The advantage of effective physical techniques that do not degrade the implant surface can then be understood.[29] The use of lasers meets this requirement and seems to give the best results.[30-31-32]

In the case of advanced alveoloclasia, we must be vigilant and not jeopardize the possibilities of being able to re-implant subsequently. The quantity of remaining bone must be assessed. If necessary, we must not hesitate to explant in order to avoid subsequently the heavy bone reconstruction techniques.

Even in the case of explantation, even more so when the area is infected, laser treatment is beneficial.

The effects of bone biostimulation seem to activate the local repair potential. The laser radiation sources give very different effects: CO_2, Diode, Er:Yag, Nd-Yag, etc. and not all are adapted to treatment of peri-implant lesions and decontamination of the implant surfaces.[33]

"If the very textured surfaces seem to be the best for osteointegration, conversely they seem to be the worst for the evolution of peri-implantitis."

The CO_2 lasers in particular lead to excessive raising of temperature locally.[34-35-36]

The diodes, which are very beneficial in surgery of the soft tissues, have a negative effect on metal surfaces.[37]

The Er:Yag lasers currently seem to be the most versatile and the most indicated for this type of treatment.[38]

The main action of the lasers will be at three levels:

- Removal of the granulation tissue which is performed without risk of modifying or damaging the surface finish.[39-40] With the laser it is possible to remove the granulation tissue in areas difficult to treat by conventional means. A power of 400 mJ and a frequency of 17 Hz produce energy sufficient to volatilize the tissues without damaging the bone or the implant.[41-42]

- The bone remodeling obtained with an energy of 300 mJ for a frequency of 25 Hz affects only about 30 µm of bone thickness. The effect obtained by volatilization of the infiltrated tissues also allows biostimulation and vascularization. The effect of biostimulation increases the production of PDGF and bone repair. The production of PDGF which normally stops on the

second day, remains active beyond the second week.[43] The revascularization is also more intense in the treated areas.

- Finally, the use of the laser radiation on the implant surface seems superior to any other technique to clean the surface porosities of the smear layer, the tissue debris and the bacteria. A power of 60 mJ suppresses 99.5% of the bacteria[44] while power of 120 mJ allows cleaning of 99.94% equally without degradation of the surface. The effect obtained is also positive on removal of the tartar deposits that might cover the surface of the implant.

There are some precautions to be taken, such as making sure not to be too near the implant surface and avoiding high energies. This means low dose or low energy radiation. These are powers of 120 to 150 mJ for frequencies not exceeding 45 Hz which are recommended.[45]

Conclusion

What questions should we ask when we place implants?

What percentage of our patients do we see again?

What is the frequency of the follow-up visits?

What are our examination criteria?

Are there favorable cases? Patients with better resistance?

Do we have problems with patients with a high degree of hygiene?

Have we assessed the risk factors at the time of placing the implant?

Are there more favorable surface finishes?

The object of our activity must therefore be to stop the progression of the disease by changing the peri-implant environment and acting both on the bacterial flora and the contributory agents.

The surgical treatments are the only method to be used to implement these therapies. The fragility of the implant surface is the weak point of the repair. Currently, the treatments using laser and in particular the Er:Yag lasers, show maximum efficacy. The action of the lasers in fact targets the removal of the infected tissues, the treatment of the bone surfaces and the biostimulation of the histological response of the tissues and the production of PDGF.

Finally, laser is the most efficient means of sterilizing and cleaning without modifying the implant surface.

The implant surfaces are both the key for osteointegration but also for the appearance of peri-implantitis. If the very textured surfaces seem to be the best for osteointegration, conversely they seem to be the worst for the evolution of peri-implantitis. Apart from the repair treatments, the research efforts must focus on the discovery of new surface finishes, in fact new materials.

Clinical case

Patient aged 60, treated by the clinic for the last 15 years, implants placed 11 years ago.

CLINIC FOCUS

The patient came to the clinic after the spontaneous loss of the implant and the prosthesis at location 45. No pain, the control x-ray showed a peripheral crateriform alveoloclasia of the implant located in position 46.

The prosthesis was removed and flap surgery was carried out with debridement of the infected tissues only with the Er:Yag laser because of the narrowness of the lesion. Low-energy treatment of the implant surface was performed. After volatilization of the granulation tissues, an allograft bone was placed around the implants.

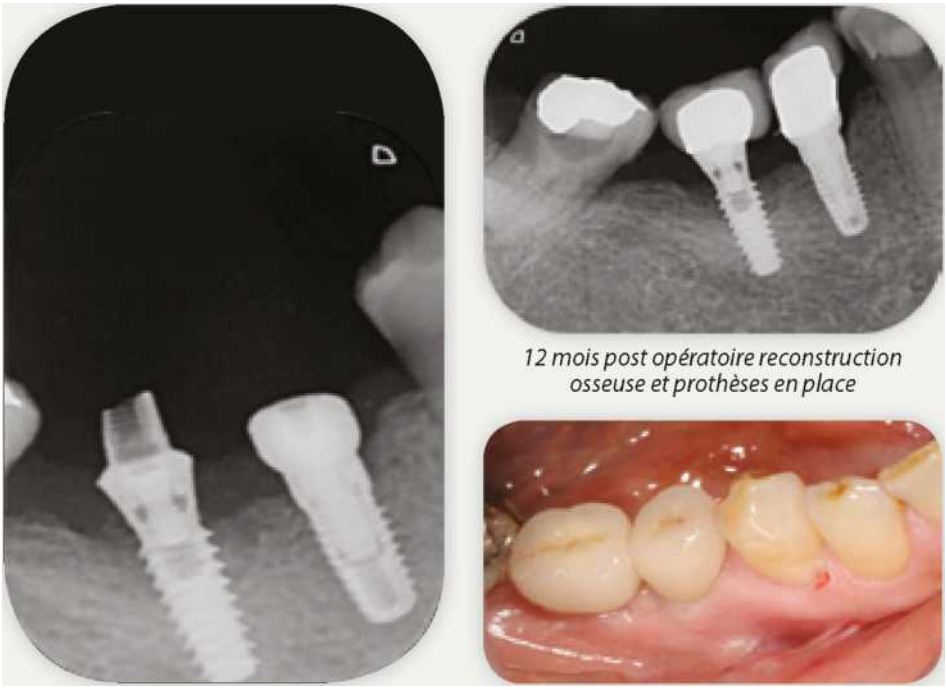
Initial state

View of the peripheral lesion at the time of the intervention

D0 after the surgery: laser + filling with an allograft bone

State of gums 5 months after surgery

12 months after operation for bone reconstruction and prostheses in place



State at 8 months after operation with replacing of an implant at location 45

Prostheses 12 months after operation

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Exhaustive list of the bibliography in the digital version of the article.

Le Fil Dentaire N° 90 • February 2014