AN ALTERNATIVE FOR CHLORHEXIDINE?

Active oxygen treatment

Surface application of active oxygen is used for promoting the healing of chronic wounds. Topical oral oxygen therapy (TOOTh) has already been successfully used in several cases in dentistry practice. A review on the basis of three cases.

by Ronald Muts

O'xygen has already been used in medicine for more than one hundred years to promote the healing of wounds. The clinical results have varied greatly, however, and have often been disappointing. Oxygen treatments were used randomly and until recently, medical treatments using oxygen still had an aura of quackery. But thanks to an improved scientific understanding of the oxygen physiology and with the help of randomised, prospective clinical studies, the classic use of oxygen in wound healing is currently seen as a recognised treatment option.[1]

Since the sixties, a form of oxygen treatment - hyperbaric oxygen therapy - has been used successfully in the Netherlands, after heart surgery, for example, and in the case of life-threatening infections with anaerobic organisms[2]. Lives or limbs can often be saved. The essence of the hyperbaric oxygen therapy is increased pressure in a pressure cabin up to 2 - 2.5 atmospheres **(image 1).**

For dentistry applications, an oxygen-producing product has recently been brought onto the market. The active oxygen treatment used for this is based on a different operating mechanism than that for hyperbaric oxygen therapy. The question is whether active oxygen is a possible alternative for chlorhexidine as a support for wound healing and tissue regeneration in the mouth.

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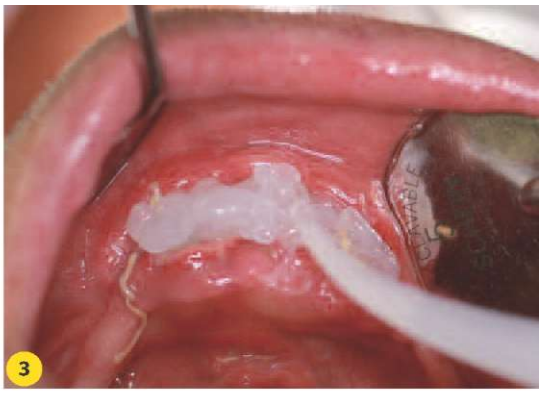
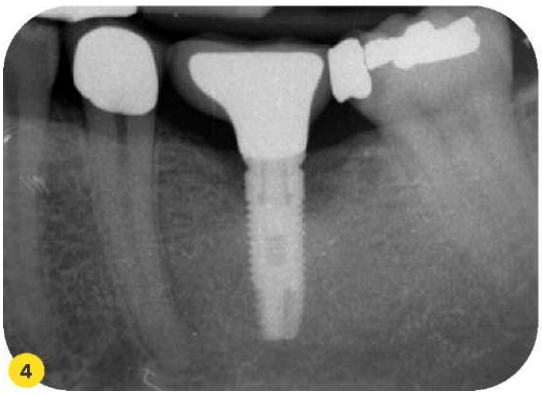
Image 1. Pressure cabine for the hyperbaric oxygen technology

Image 2 Maxillary reconstruction with bone from the crista iliaca. **Image 3** Local application of a stabilised, active oxygen producing gel on the wound bed with a monoject syringe.



Case 1 (image 4-6)
Image 4 Before treatment: peri-implantitis with a circular bone defect and a pocket of 9 mm. **Image 5** 1 year after treatment with active oxygen, a one-off initial subgingival currettage: clearly observable bone regeneration.



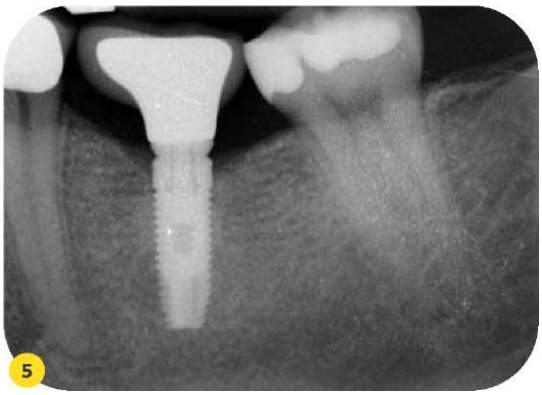


Image 6 X-ray image after 2 years of treatment with active oxygen: even more improvement.

History

Experiments have been carried out with topical oral oxygen therapy in dentristry, primarily in larger maxillary reconstructions using bone from the crista iliaca **(image 2).** In such reconstructions, bone loss regularly occurs as a result of dehiscences and necrosis of the exposed bone. In attempts to prevent such bone loss, and with the good results from hyperbaric oxygen therapy in mind, active oxygen was applied locally by means of a stabilised, active oxygen producing gel **(image 3).** According to the dental surgeons carrying out the experiments, it was a notable clinical experience that fewer complications occurred, and that the healing process progressed faster and better.

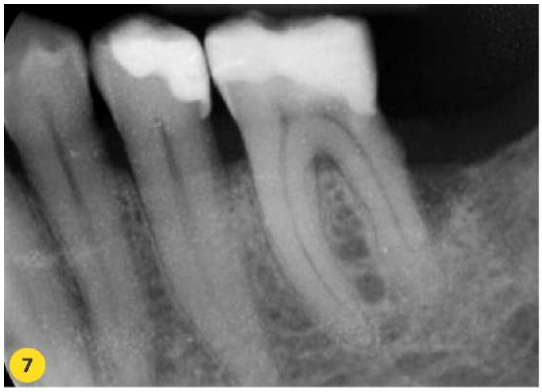
We wondered whether these beneficial experiences would also lead to similarly positive results in dentistry practice. This question led to a couple of cases, three of which I will discuss below.

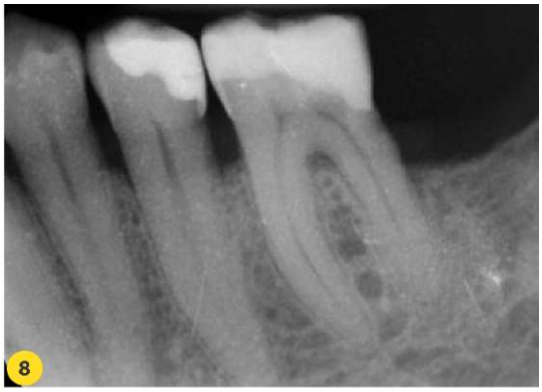
Case 1 *(image 4-6)*

A 39-year-old man presents himself as a new patient in 2011. During the intraoral examination, we notice around the implant of tooth 36 a peri-implantitis with a circular bone defect and a pocket of 9 mm **(image 4)**. After extensive oral hygiene instruction, we curette, in a closed situation under anaesthetic, the mucous membrane around the implant of tooth 36 in order to create a fresh wound bed. We do not clean the implant surface in this context. Immediately after this, we apply the active oxygen based Oral Gel (bluem) in accordance with the newly developed advice (the TOOTh advice), which will be described below.

After one year, another x-ray is taken **(image 5).** On this image, new bone growth around the implant is clearly visible, both in horizontal and vertical direction. The probed pocket depth (Williams) is reduced from 9 to 4 mm. The redness and the swelling of the peri-implant tissue have disappeared, the mucous membranes ►

Case 2 (image 7-8)
Image 7 Angular bone defect distal of tooth 36 with a pocket of 8 mm before treatment.
Image 8 New bone ingrowth 2 years after treatment with active oxygen and one-off initial subgingival currettage.





Case 3 (image 9-11)
Image 9 Peri-implantitis 35 before treatment with active oxygen.

Image 10 Solo image with a peri-implantitis around tooth 35 before treatment with active oxygen.
Image 11 Result two years later, after peri-implantitis surgery during which the cement residue encountered was removed, and after daily application of active oxygen.

is tight around the implant again, and there is no longer any bleeding after probing.

Another year later **(image *6)*** we can see that the bone ingrowth has been maintained. There even appears to be a slight improvement, and the pocket depth has been reduced further to 3 mm. This result is probably due in part to highly disciplined adherence by the patient to the instructions in accordance with the TOOTh advice.

Case 2 (image 7-8.

In a 59-year-old man, local periodontal problems have occurred at the site of tooth 36. **Image 7** shows an angular bone defect distal from tooth 36 with a pocket depth of 8 mm and an attachment loss of 9 mm. In this patient, under anaesthetic, the pocket was first cleaned ultrasonically and then with a manual instrument. Instruction was then given in accordance with the TOOTh advice.

The x-ray taken two years later **(image 8)** shows new bone growth in the angular area, and the pocket depth has been reduced to 4 mm. The bone level distal has returned to the same height as the bone height mesial. This result has also partly been achieved due to a cooperative attitude of the patient and strict adherence to the instructions according to the TOOTh advice.

Case 3 (image 9-11)

In a 62-year-old female patient, we encounter a peri-implantitis in 2011 - clearly visible both on the OPT images **(image 9)** and on the solo x-ray **(image 10)**. The maximum pocket depth we measure is 12 mm.

We expose the implant using a flap operation, in which context we encounter cement residues around the implant. We then clean the implant surface with curettes and 35% phosphoric acid. bluem Oral Gel is then applied to the implant surface, and to the flap after ►

stitching. We instruct the patient to apply the oxygen gel three times daily around the implant, and to rinse three times daily with the bluem mouth rinse. After two years, a check-up x-ray **(image 11)** is taken of the patient, who comes for regular check-ups. This x-ray agrees with the clinical finding: the pocket depth has been reduced to 4 mm.

Action of the active oxygen products

In order to increase the action of active oxygen locally in the wound area, use can be made, along with an application agent, of both low concentrations of sodium perborate and of the enzyme glucose oxidase (GOx). In contact with water, sodium perborate is converted into sodium borate and H_2O_2. GOx ensures a gradual conversion of glucose into gluconic acid and H_2O_2. GOx, which is normally dormant, becomes active again under the influence of moisture, for example from a wound. Small quantities of gluconic acid and hydrogen peroxide are released very gradually.

In low concentrations of 0.003%- 0.015%, hydrogen peroxide has a disinfectant[3] action, and occurs, together with the antibacterial ROS (reactive oxygen species) during the respiratory burst of neutrophiles in normal wound fluid[4,5] and has a chemotactic effect on leucocytes [6]. The concentrations of hydrogen peroxide in the products used are not comparable to the high concentrations (1.5 – 3%) of hydrogen peroxide used in medicine as a disinfectant. It is known that the production of free radicals then causes damage to the wound .[3,7] Research has shown that the continuous presence of a low concentration of hydrogen peroxide kills pathogenic bacteria much more effectively than a one-off high concentration[8] and that fibroblasts are not damaged by this .[9]

Discussion

Wound healing is an extremely complex process. Although the local use of a low dose of H_2O_2 has a proven positive effect on wound healing [3], the exact action mechanism of stabilised oxygen preparations on wound healing in general and on tissue regeneration in dentistry in particular is not yet fully understood, and requires further research. It is possible that there are other factors, as yet not known or understood, or a combination of factors which promote tissue regeneration. In addition, the described advice for application of active oxygen gel is only a proposal for a standardised treatment, which may be subject to modifications in the future. This is also the reason the therapy used in case 3 differs slightly from the advice developed later. Reference is made emphatically to the fact that the active oxygen therapy is based on the use of physiologically low-dose hydrogen peroxide and should not be compared to the 1.5–3% concentration which is usual for use as disinfectant in dentistry, and which can instead actually cause tissue damage.

Disadvantages and side effects are also known for other antimicrobial agents, such as chlorhexidine digluconate, which is frequently used to support[10] periodontal treatments (including the treatment of peri-implantitis).[11-13] It disrupts the mitochondrial function in cells, causes an increase of intracellular Ca^2+ and oxidative stress, and

TOOTH ADVICE FOR POCKET REDUCTION WITH BLUEM IN PARODONTITIS AND PERI-IMPLANTITIS

1. Record the initial situation on an x-ray on which the bone progress can be clearly seen; measure the pocket depth, the recession and the bleeding.
2. Make an acute wound bed using curettage around the implant, and root planing around a natural element.
3. Put a small amount of bluem Oral Gel in a disposable 2.5 ml syringe (Terumo), screw the black minitip (Ultra-dent) on to this. Apply the gel in the pocket around the element.
4. Give the patient instructions and apply according to the regime below:
   - ***a*** 2x daily brush with bluem toothpaste.
   - ***b*** 2x daily rinse for 1 minute with bluem mouthwash.
   - ***c*** 2x daily interdental cleaning with bluem Oral Gel at the site of the element in question, or if the patient is able, have the gel applied in the pocket in the evening before going to bed, using the 2.5 ml syringe (Terumo) and black minitip (Ultradent).
5. Evaluation after 2 weeks.
6. Followed by checkups after 4 and 8 weeks. If the situation remains stable and quiet, subsequent checkups every 4 months. Check pocket depth, recession and bleeding at each visit.
7. After 1 year, take control x-ray. Check pocket depth, recession and bleeding.

can lead to apoptosis. Osteoblasts, in particular, are sensitive to the cytotoxic action of chlorhexidine. For this reason, caution is advised with regard to their use as an antiseptic in dentistry.[12] The local use of oxygen as support for wound healing and tissue regeneration is a possible alternative for chlorhexidine. It is hoped that research currently taking place will provide more clarity in this respect.

Conclusion

In none of the three cases were the results achieved with bluem alone. This means that the level of recovery could also have been the result of the treatment itself (curettage/surgery). Although the cases shown are very promising and the influence of the application of active oxygen in wound healing in medicine and in dentistry may be far-reaching, caution should be taken due to the limited case history and the lack of a comparison with a control group. It is therefore by no means the intention of this article to put forward evidence, and it is only intended to identify a possibly interesting trend in the area of active oxygen therapy in dentistry.

The list of references for this article can be requested via the e-mail address <redactie-tp@planet.nl>.