Bone & Periodontal Regeneration using Calcium Hydroxide

Dr. Udo Krause-Hohenstein
Periodontist

Prof. Dr. Georg Dietz (Munich) was already interested in bone regeneration and calcium hydroxide (CaOH) more than 20 years ago. Dietz published 1998 together with Prof.Dr. Peter Bartholmes and Dr.Wolfgang Röcher the book "Calcium Hydroxide and Bone Regeneration", reporting at length about alcium hydroxide's effect on bones.

My generation learned extensively that calcium hydroxide in contact with bloody tissue generates a necrobiotical zone. A calcite membrane develops, which reduces a deep acid burning, preventing a deeper penetration. This is an aqueous CaOH solution, which has a necrobiotical effect. Dietz found out by chance that the "oily" CaOH suspension had a beneficial bone regeneration effect. What are the respective interrelational changes ccurring in aqueous and oily calcium hydroxide suspension?

While the aqueous CaOH suspension builds a calcite membrane that prevents a deep acid burning of the tissue, the oil in the oily CaOH suspension prevents an acid burning of the bloody tissue. An oily protective cell layer develops, whereby calcium hydroxide in the oily suspension cannot react with the body water. Thus a necrotical effect does not take place.

Oil Does Not Mix With Water

The CaOH effect in the oily solution is gradually generated by oil resorption, whereby small calcium hydroxide quantities are released, which being slight, cause no acid burning, but only an alkalization of the environment. Hours after, the ph-value rises to 8 – 9 and reaches locally a plateau at this value, which will be maintained for days, as long as the inserted calcium hydroxide is being dismantled. The oily suspension has a depot effect: the oil resorption and calcium hydroxide release happen only on the surface having contact with the aqueous environment. This process can last days and weeks.

Effect On Collagen Synthesis Activity

It has been proved that the oily CaOH suspension causes a noticeable increase in collagen synthesis activity in human tissue. In his inaugural dissertation in 1995 Röcher accounted for incremental factor 9 (best case) in collagen biosynthesis. Consequently, in using Osteora®, strongly enhanced collagen biosynthesis and thus also osteoblasts activity is provided for.

Frank Schwarz, Stefan Stratul, Monika Herten, Brigitte Beck, Jürgen Becker and Anton Sculean studied Osteora®'s effect in periodontal bone defects in dogs. The dogs treated with Osteora® displayed to great extent new cementum and new bone. The untreated control group displayed a long junctional epithelium. In contrast, the defects treated with Osteora® displayed new bone formation in combination with newly build cementum.

A connection between the oily and aqueous phase is at no time possible, thus calcium hydroxide is being released only at the separating layer between oily and aqueous solution.

Osteoblasts growth

The above mentioned scientists studied the cell growth of fibroblasts and human osteoblasts under the influence of oily CaOH suspension. It was determined that the osteoblasts developed a logarithmical growth under the influence of an oily suspension.

Stronger Activity

A long-time osteoblasts culture under the influence of oily calcium hydroxide suspension was analyzed. Osteoblasts' behaviour relative to an oily calcium hydroxide suspension (Osteoinductal® now Osteora®, purchase through MetaCura GmbH, Munich) was documented for a period of 4 months. A strong osteoblast differentiation was noticed under Osteora®'s influence, as opposed to a non-influenced cell culture. The culture cells showed in the presence of Osteora® a three times stronger activity, as compared to non-influenced cells. Dietz points out an analgesic, antiinflammatory and bacteriostatic effect of the oily calcium hydroxide suspension. In 2005 Stefan Stratul, Frank Schwarz, Jürgen Becker, Brita Willershausen and Anton Sculean studied on 30 patients Osteora®'s effect on healing bone defects. They determined Osteora®'s good compatibility. The lesser post surgery swellings indicated a stronger antiinflammatory effect.

They noticed Osteora®'s effect in bone defects to be similar to the one induced by enamel matrix proteins. The newly build root cementum revealed a well organized periodontal ligament. Thus, the treatment with Osteora® was validated as more effective than the one in the control group.

Osteora® group had no complications. It is assumed that the product's positive effect in periodontal wound healing accounts for the stimulation of enzyme activity on the osteoblasts, which is to be traced back to the collagen biosynthesis, as Dietz and Röcher pointed out.

Kasaj, Willershausen, Berakdar, Tekyatan and Sculean analyzed Osteora®'s effect on early wound healing after non-surgical periodontal therapy on 19 patients with chronical periodontitis. The result showed an improvement in early wound healing process. No inflammations and less bleeding were noticed after applying the product. The utilization of the oily CaOH suspension has been compared with the tested wound healing of enamel matrix proteins.

Meanwhile, a 12-months clinical analogy between Osteora® and Emdogain® regarding bone pockets has been completed (Stratul, Willershausen and Sculean). Both products induced an effective healing, meaning the depth of the pockets had been reduced considerably and the CAL too. The difference between Emdogain® and Osteora® was not worth mentioning.

After studying these papers, I initiated the multiple use of Osteora® in my practice: filling alveoli, bone pockets surgery for bone regeneration, with or without TCP (tricalcium phosphate), mixed with TCP in maxillary sinus filling in case of maxillary sinus lifting. All results have been more than satisfactory, as documented by photos and X-rays.

Legends

Open curettage (Fig. 1 – 6)

Fig.1 After pocket opening with needle electrode, the fibres are cut with Perio-Pro to facilitate the raise of the flaps.

Fig. 2 The root surface with the bone pocket is cleaned, with Perio-Pro instead of a scaler, and flattened.

Fig. 3 Osteora® (before named Osteoinductal®) is inserted directly from the syringe into the approximal cavity. Blood-free state is not imperative.

Fig. 4 24 hours post operative: notice the dense and inflammation-free marginal parodontium.

Fig. 5 After cleaning and flattening of the root surface region 11 to 22 with Perio-Pro – the root surface free of biofilm.

Fig. 6 2 ½ months post operative: marginal parodontium is inflammation free and with pockets 3-4 mm deep, without wound dehiscence, the same frontal. The incisal papilla was preserved.

Filling of the op area of a surgically removed tooth with plastical wound covering (Fig. 7-8)

Fig. 7 After tooth 24 osteotomy, the alveolus is filled with Osteora®.

Fig. 8 Afterwards the alveolus is tightly sutured.

Filling a deep pocket with Osteora® mixed with TCP (Fig. 9-10)

Fig. 9 The isolated granulation in the deep pocket between 42 and 43 is removed with Perio-Pro.

Fig. 10 The pocket is filled with Osteora® mixed with TCP powder from the drugstore and then tightly sutured.

Maxillary sinus lifting before implantation with Osteora® and TCP (Fig. 11-13)

Fig. 11 OPG before implantation: initial situation in the 2nd quadrant with a deep periodontal pocket distal 24.

Fig. 12 OPG after implantation: clearly visible in the 2nd quadrant: the 24 filled up pocket with alloplastic bone substitution material and Osteora® and the filled up maxillary sinus with Osteora®, alloplastic bone substitution material and membrane.

Fig. 13 OP clinical photo after 3 months with accomplished bone regeneration under membrane at 24 and implants at 25, 26, and 27.

Treatment of an alveolus with Osteora® after extraction (Fig. 14-16)

Fig. 14 X-Ray: initial situation pre extraction at 26.

Fig. 15 Filled up alveolus after extraction with Osteora® after ample curettage.

Fig. 16 3 days post extraction and filling up with Osteora®. The wound was covered up with prosthesis. The wound is completely inflammation free. Due to the filling with Osteora®, favourable bone regeneration occurs, as here an implantation is planned.

Maxillary sinus lifting with Osteora® and TCP (Fig. 17- 20)

Fig. 17 Left maxillary sinus before lifting with Osteora® and alloplastic bone substitution material (TCP).

Fig.18 The maxillary sinus filled up with Osteora® 8 months post operative.

Fig. 19 The maxillary sinus filled up through small access, before membrane application. The attempt to simultaneously insert the implant failed.

Fig. 20 After suture, the complete area is covered with a mucosa dressing (Mucotect).