

The role of aqueous nanocrystalline hydroxyapatite in oral bone regeneration

It is expected by clinicians to generate high stability with granular hydroxyapatite. Some of this conventional granula have the disadvantage of a very long resorption time and does not really support dental implants by a real own patient bone. SinossInject is a synthetic nanocrystalline hydroxyapatite in a paste form which allows filling of a wide range of bone defects and leads to a new bone formation within 12 months.



Fig. 1: The nanocrystalline SinossInject is highly biocompatible with high affinity to host bone but with higher solubility than conventional hydroxyapatite preparations.

In a nutshell, it can be said: Clinicians expect bone augmentation material with rapid new bone formation and resorption to generate new vital bone. Often these requirements contradict each other. Most of the commercial natural or synthetic hydroxyapatites are developed and manufactured in conventional granular shapes to achieve adequate augmentation of bone defects. This traditional shape has some drawbacks when filling bone defects where surgical areas are difficult to reach, too small or hard to handle. Some clinical situations and bone defects, like cysts and post-extractive cavities of the maxillary bone, have the need for additional appliances when filled with granular hydroxyapatite.

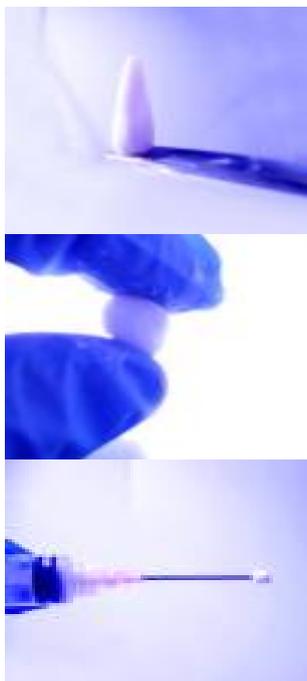
The pasty shape of SinossInject enables a simple and fast injection into the defect and reduces the efforts regarding augmentation. It is the need to follow of the instructions for use in detail. The injected SinossInject will attach to bony walls without the need to cover the defect - the need of a collagen membrane is an option - except for flap repositioning. That procedure lead to prevent a second surgery. Rather than act as an impermeable wall the aqueous nanocrystalline hydroxyapatite bone graft material quickly breaks up into small structures of various shapes and sizes and transform these structures into a interposed soft tissue on which new bone may grow. The transformation of the SinossInject is a process of three incidents: bone cleaning, angiogenesis, and percolation of fluid inside the mass of SinossInject. The walls of the bone defect experiences a surgical trauma and could lead to remodeling. In this sequence, space is created for the pasty mass of SinossInject and new tissue can develop from the first processes of

vascularization. The fluids of the percolation can spread out within the mass of SinossInject. The early dissolution of SinossInject allows calcium and phosphorus to be released and has an osteoinductive effect on progenitor stem cells and initiates new bone formation. Supportive effects on new bone formation and remodeling can be achieved by mechanical stress and degradation by the activity of the osteoclasts. The transformation into new patient bone takes place from outer places to the core of the defect because the inner particles of SinossInject undergoes a slower process of remodeling.

Material and methods

A group* of dentists did treat 15 patients with a mean age of 50.5 years including bone augmentation at the site of tooth extraction prior to implant insertion. These group did following protocol: In all patients the edentulous area extended for three to four adjacent teeth distal to the maxillary canine with a residual bone thickness under the sinus floor not exceeding 4 mm. A conventional antero-lateral access was opened as described by Tatum. The sinus floor was completely grafted with aqueous nanocrystalline hydroxyapatite after raising the Schneiderian membrane from the lateral to the medial sinus wall on a coronal plane and mesiodistally over the length of the edentulous area. Implant insertion was performed 6 to 9 months after surgery using conventional rotary instruments. Three patients were treated for post-extraction defects of the first premolar of maxilla. The aqueous nanocrystalline hydroxyapatite was injected by overpacking the alveolus about 1 mm over the vestibular edge wall.

The vestibular flap was released with periosteal incisions and coronally sutured, creating the primary wound roof. Implants were inserted 6 to 7 months after surgery. Sutures were removed 14 days after reconstructive surgery. Monthly follow-up was scheduled to check for wound dehiscence up to implant insertion.*



Results

In the following, only partial results of the investigation are described as follows: Six to seven months after implant insertion and augmentation has been detected a well-integrated aqueous nano-crystalline bone augmentation material. This bone augmentation material could not be distinguished radiologically from the existing patient bone. In the upper jaw or sinus lift, the radiographic density of the bone was uniform and could not be differentiated from the newly obtained bone and provided good primary stability for all inserted implants. The further investigation seemed to have been based on the biopsy vascularized cortical and

The group*** of Shirmohammadi, Roshangar, Chitsazi, Pourabbas, Faramarzie, Rahmanpour have shown by histological findings a significant increase in percentages of new bone in the group of aqueous nanocrystalline bone graft material in comparison to a natural bone graft material. The density of the new bone has been higher with aqueous nanocrystalline bone graft material compared to the natural bone graft material.

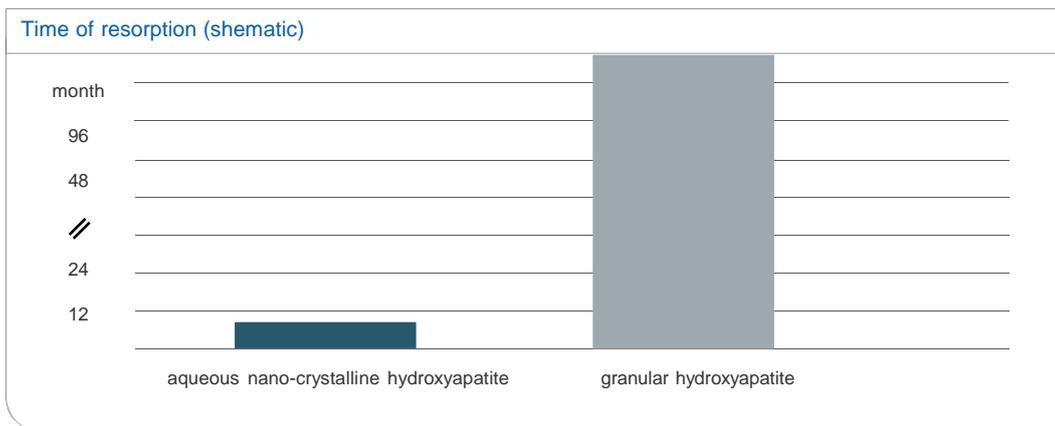
In the treatment of periodontal intrabony defects could shown findings by Chitsazi, Shirmohammadi A, Faramarzie M, Pourabbas R, Rostamzadeh An.**** excellent results in a direct comparison between autogenous bone graft and aqueous nanocrystalline bone graft material. The results shown statistically significant progress in soft and hard tissue parameters after 6 months except in gingival margin level and crestal level. The differences between autogenous bone graft and aqueous nanocrystalline bone graft material were not statistically significant after 6 months with regard to soft and hard tissue measurements.



spongy bone and bone trabeculae. The highest degree of substitution was found in areas where the nano-crystalline bone regeneration material had disappeared. The few particles of the nanocrystalline bone regeneration material present in the biopsies were almost always completely surrounded by newly formed bone.

The dental journal Schweiz. Monatsschr. Zahnmed. **** did publish results and conclude that the use of the aqueous nanocrystalline hydroxyapatite graft with its stable volume properties could be suitable for maxillary sinus floor augmentation. Additional it has been confirmed osteoconductive bone regeneration under aqueous nanocrystalline graft near the site of a loosened implant. An aqueous nanocrystalline hydroxyapatite graft resorbs completely and provide fast bone regeneration of jaw defects with no complications during the healing period.





The ionic dissolution rate in aqueous nanocrystalline bone graft material is much higher than in conventional hydroxyapatite and due to its nanostructure from a technical point of view closer to natural apatite. Derived from this, the aqueous nanocrystalline bone material has superior resorption behaviour.

The particles of SinossInject have a grain size less than 100 nm and must be placed in direct contact with the existing vital bone bed because only then can take place the revascularization with subsequent bone regeneration. In an avital bone bed SinossInject has no effect, as no bone-forming cells can migrate as a result of a lack of vascular grafting. Many studies have shown that the inserted implants were osseointegrated at the time of exposure. As well have been present clinically and histologically no signs of inflammation in the augmented sites. The authors** Dau M1, Kämmerer PW1, Henkel, Gerber, Frerich, Gundlach have highlighted that aqueous nanocrystalline hydroxyapatite, the residual bone defect after 5 weeks was significantly less compared to synthetic granular hydroxyapatite or natural granular hydroxyapatite.

In addition these group line out that the remnants of bone graft material in aqueous nanocrystalline bone graft material have been significant lowest rate compared to synthetic granular hydroxyapatite or natural granular hydroxyapatite. And provided the least volume of soft tissue and the highest volume of new bone after 5 weeks. Eight months after reopening have been no significant differences between aqueous nanocrystalline hydroxyapatite, synthetic granular hydroxyapatite or natural granular hydroxyapatite. Except the significant lower rate of residual material in the aqueous nanocrystalline hydroxyapatite.

Conclusion

The efficacy of aqueous nano-crystalline hydroxyapatite is the faster resorption and new bone formation compared to conventional granula hydroxyapatite. Therefore SinossInject represents a promising alternative to conventional natural granula hydroxyapatite and autologous bone for the treatment of some bone defects. The results of this dental groups show that conventional granular synthetic and natural hydroxyapatites have a huge disadvantage because these conventional granula exist in grafted defects for 6 to 9 years or more. The effective dissolution of aqueous nanocrystalline hydroxyapatite like SinossInject in less than 12 months to a bone structure that is nearly completely built of bone, the perfect tissue for supporting dental implants.



*References

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