# Maxillary Sinus Grafting with (NanoBone®) Hydroxyapatite Embedded in a Porous Silica Gel Matrix in Humans: Histological, Histochemical, and Histomorphometric Results

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**OBJECTIVE:** To evaluate the amount of new bone after sinus floor elevation (SFE) with a synthetic bone substitute material consisting of hydroxyapatite embedded in a porous silica gel matrix (NanoBone®/NB), since information about new biomaterials is scarce in humans.

**MATERIAL & METHODS:** The lateral bone window approach was applied in eight patients requiring an SFE procedure to install dental implants. After elevation of the Schneiderian membrane, the cavities were filled with 0.6 mm granules of NB mixed with the patients' blood and a collagen membrane (Bio-Gide®; group 1) or a platelet-rich fibrin (PRF) membrane (group 2) was placed over the bony window. After 7-11 months of healing (in one case after 24 months), 16 biopsies were harvested during implant bed preparation. After aldehyde fixation, the samples were decalcified in EDTA and embedded in LR White resin. Sections were stained with basic fuchsin and toluidine blue. The percentage of new bone, residual filler material, and soft tissue was determined histomorphometrically. In addition, sections were histochemically treated to detect tartrate-resistant acid phosphatase (TRAP) enzyme activity, normally being associated with osteoclast-like cells.

**RESULTS:** Four biopsies had to be excluded from the analyses, since only old bone from the residual ridge was contained in the trephine due to incomplete tissue retrieval. In the augmented region of the remaining 12 biopsies, new bone formed a dense network of evenly distributed bone trabecules interconnecting with neighboring NB particles **(Fig. 1)**, which were structurally inhomogeneous and appeared porous **(Figs. 2-3)**. Numerous large, multinucleated **(Figs. 2-3; arrows)** and TRAP-positive cells **(Figs. 4-5)** were mainly observed at the soft tissue-NB interface. The morphometrical results are shown in **Fig. 6**. For group 1, the amount of new bone, residual filler material, and soft tissue was 28.7%±5.4, 25.5%±7.6, and 45.8%±3.2, respectively. For group 2, the corresponding values were 28.6%±6.9, 25.7%±8.8, and 45.7%±9.3. All differences between groups 1 and 2 were not statistically significant. The lowest and highest values of new bone were 21.2% and 34.1% for group 1 and 17.4% and 37.8% for group 2, respectively.

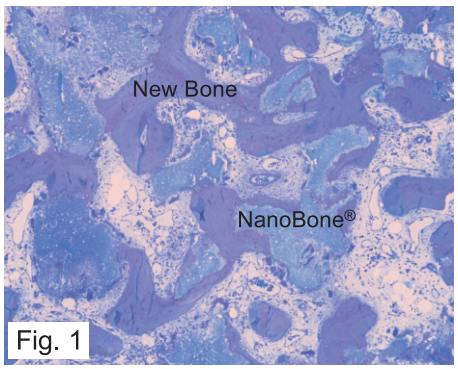

Fig. 1

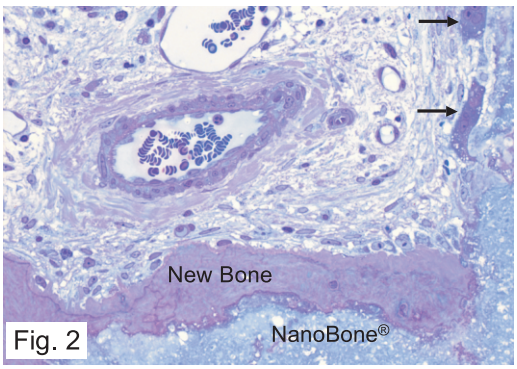

Fig. 2

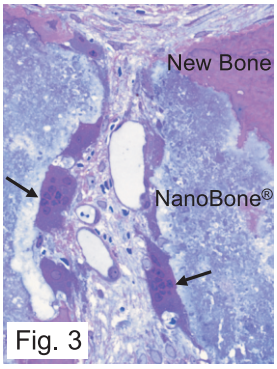

Fig. 3

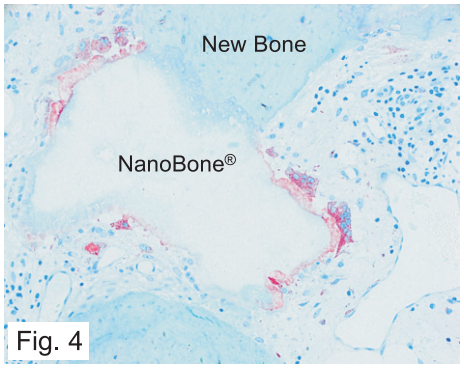

Fig. 4

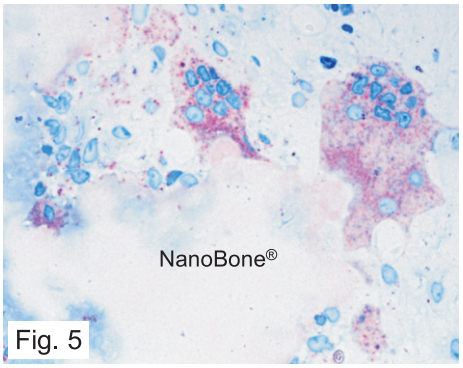

Fig. 5

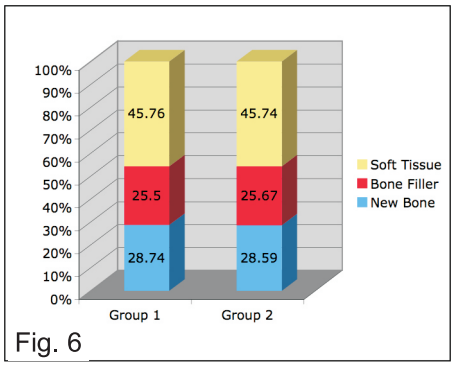

Fig. 6

**CONCLUSIONS:** The amount of new bone after the use of NB for SFE in humans is comparable to the highest values found in the literature for other synthetic or xenogeneic bone substitute materials such as Straumann BoneCeramic® or Bio-Oss®. Concerning the amount of new bone, there was no additional beneficial effect of the PRF membrane over the Bio-Gide® membrane. TRAP-positive osteoclast-like cells appear to be involved in the degradation of the synthetic biomaterial.

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