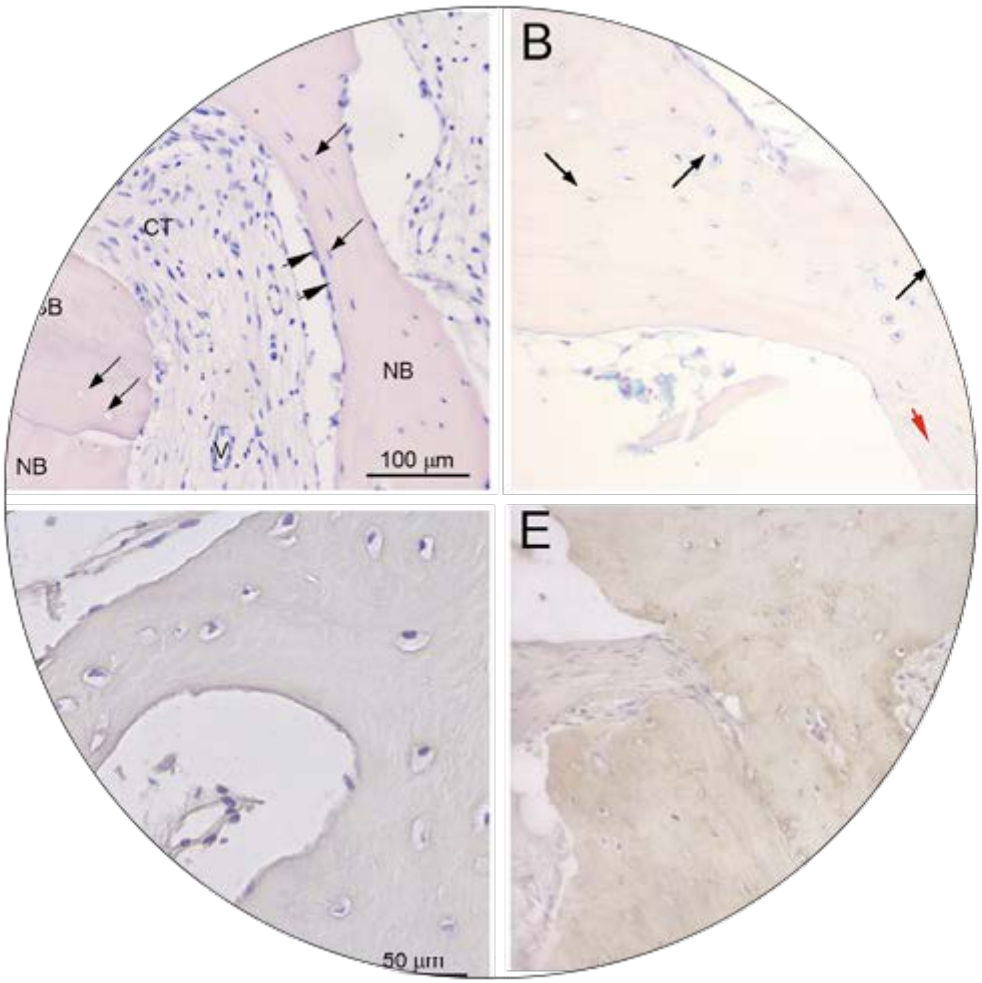
smartbone®

integration

Notes from a human histologic study



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4 months

Biopsies at 4 months already provide an extensive characterization of the graft substitution, showing a co-existence of SmartBone and newly formed bone. SmartBone is stained with less intensity than new bone and its bone lacunae do not contain any osteocytes, thus allowing its easy identification in the histologic sections, while new bone areas showed osteocytes housed in the bone lacunae and osteoblasts layering at the periphery of new bone grown on SmartBone. Good osteoconductivity is proved also by the presence of well-structured surrounding connective tissue with a rich network of blood vessels, indicating acceptance and integration of the graft material in the recipient site.

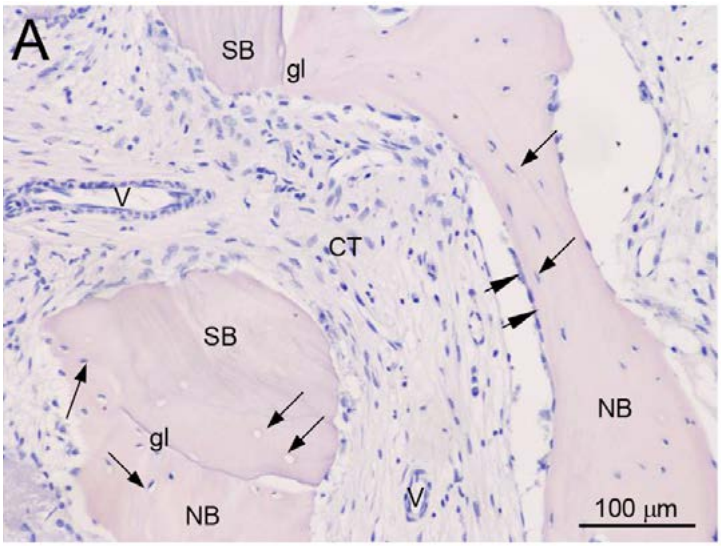

Figure 1: H&E staining of bone biopsy after 4 months from SmartBone grafting. Original magnification 200. NB = new bone; SB = SmartBone; CT = connective tissue; gl = growth line; V = blood vessels; black arrows = bone lacunae; black arrowheads = osteoblasts.

6 months

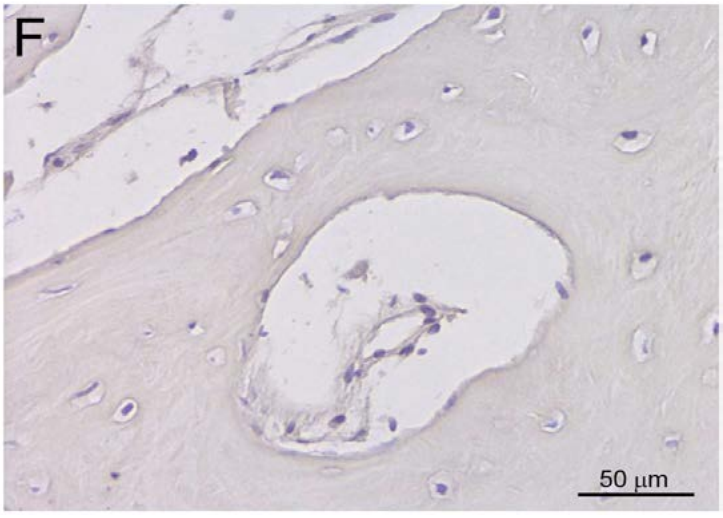

Figure 2: Histological analysis on biopsy after 6 months from SmartBone grafting. Original magnification 400.

From 6 months ahead, SmartBone starts to be completely resorbed and only new bone areas are visible: biopsies clearly show large new bone areas containing osteocytes in bone lacunae, whereas SmartBone particles are extremely rare. In new bone areas, a good positivity for glycoproteins is shown and a strong presence of generic glycosaminoglycans is revealed in the extracellular matrix surrounding the bone lacunae. Comparison with other graft materials indicates that SmartBone is able to accelerate new bone formation.

7 months

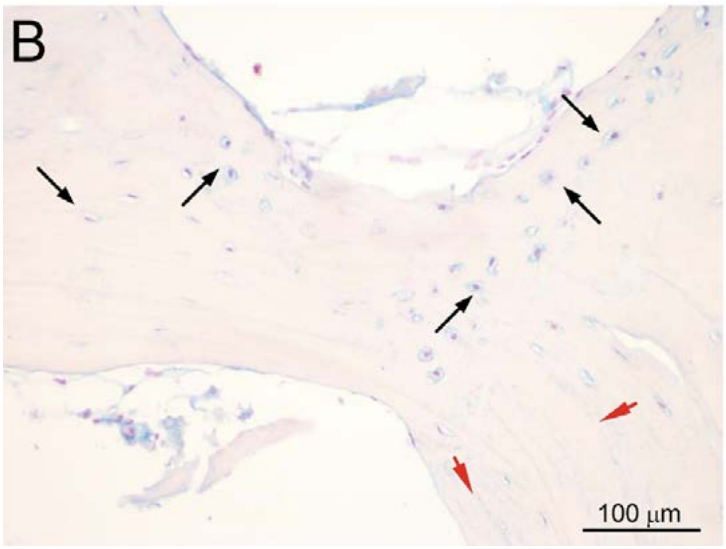

Figure 3: AlcianBlue at pH2.5 on biopsy after 7 months from SmartBone grafting shows generic GAGs in cyan. Original magnification 400. Black arrows=bone lacunae; red arrows = bone scar; black arrowheads = osteoblasts; red arrowheads = bone lamellae.

In the 7-month biopsy, well oriented bone lamellae are visible and the presence of some bone scars, typical of mature bone, can be already seen, much earlier with respect to any other bone substitute. Indeed, SmartBone is already rarely present (1%) as new bone covers almost completely the sample areas with volume percentages of about 80% and connective tissue is reduced to about 19%, proving substitution capabilities similar to those achieved only by using particulate autografts.

9 months

In the 9-month biopsy, new bone areas containing osteocytes in the bone lacunae and many bone scar lines are imaged, while SmartBone is absent: glycoproteins are well expressed mainly in the bone scars, well oriented collagen fibers are detected, collagen type I is observed along the bone lamellae, osteocalcin is well expressed in the bone areas and weak TGF- b1 expression is observed in the cells located along the margin of the bone tissue.

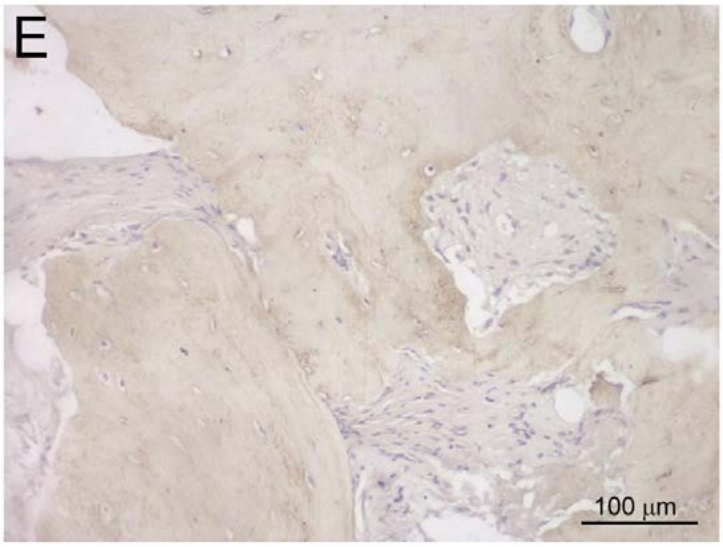

Figure 4: AlcianBlue at pH2.5 on biopsy after 7 months from SmartBone grafting shows generic GAGs in cyan. Original magnification 400. Black arrows=bone lacunae; red arrows = bone scar; black arrowheads = osteoblasts; red arrowheads = bone lamellae.

These findings all confirm complete substitution of SmartBone with new healthy bone that has completed maturity after a fast remodelling process. SmartBone is hence the ideal material for bone regeneration: highly porous, non-immunogenic, biostable until the new tissue formation, bioresorbable and osteoconductive.

All images are taken from: D. D'Alessandro, et al., *Bovine bone matrix/poly(L-lactic-co-ε-caprolactone)/gelatin hybrid scaffold (SmartBone®) for maxillary sinus augmentation: A histologic study on bone regeneration*, Int J Pharmaceut (2016), http://dx.doi.org/10.1016/j.ijpharm.2016.10.036