

The Use of a Nanoparticles Hydroxylapatite Gel as a Bone Substitute.

C.Schwartz, S.Malincenco & R.Bordei

Service d'Orthopédie et de Traumatologie, Colmar, F

INTRODUCTION: Synthetic bone substitutes are more and more used in orthopaedic and trauma surgery. Biphasic ceramics give good results but are very slowly and incompletely integrated in new-formed bone. Moreover they are not easy to use in certain circumstances because of their rigidity primarily.

METHODS: We used from July 2003 to October 2005 a new injectable bone substitute in hundred cases of trauma and orthopaedic surgery.

The substitute is a matrix of synthetic hydroxylapatite nanoparticules in water. It is elaborated by precipitation without sintering. The crystals remain in their initial needles form about 18 nanometres size. They are as agglomerates of approximately 100 x 5 nanometres in the gel. It presents as an odourless white injectable paste, sterilized with gamma rays; its pH is neutral, its solubility about 2.6 mg per 100 g of water; the most important character is its specific surface about 100 square meters pro gram. It is viscous and remains without hardening in situ. Its application by injection brings a close contact between the product and the surrounding osseous layer. It is stable in its volume, without being eliminated by blood, but does not have any mechanical resistance.

We used this substitute for filling 48 tibia open osteotomies stabilised by plates and screws; medium opening angle was 9°. In none case autograft was associated. In 4 cases biopsy was done after 6 to 12 months when plates were withdrawn. Classical histology, TEM and XRD were done.

RESULTS: In 4 cases we saw an asymptomatic aseptic flow, which dry itself up in 15 to 20 days without any treatment. Not other complications were seen; consolidation of the osteotomies occurred in 6 weeks, perhaps faster than with biphasic ceramics; it occurred in all cases except one; to early weight bearing delayed the consolidation to 3 months without new operation but only plaster cast and rest.



Post operative and 6 months X Rays

Because of its nanocrystalline structure, the substitute is quickly degraded with formation of new bone which stimulates the cure of osseous lesion. Biopsies showed a rapid micro-vascular invasion and fast colonization by pro osteoblasts then differentiation of those with collagen fibre deposition. The resorption is done by macrophages which invade the site with moderated, focal, giant cells reaction in contact with the material.

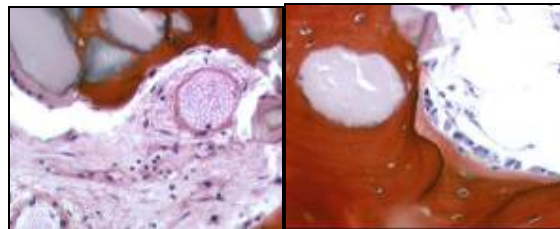


Fig.1: Biopsy 6 months : angiogenesis, osteoblasts with osteogenesis

DISCUSSION & CONCLUSIONS: The surgeon appreciated the easy way to use this injectable product. He was anxious to see the flow in some cases but reassured when cure without new treatment. Studies are in progress to find the reason of this flow. Bone consolidation was ever fast and good quality; it seems to be a new interesting and practical way for bone substitution in orthopaedic and trauma surgery.