

Voyaging around nacre with the x-ray shuttle: from bio-mineralisation to prosthetics via mollusc phylogeny

D. Chateigner, M. Morales, L. Lutterotti

In the 1970's, A. Bobbio analysed Maya cranes exhibiting nacre teeth, and discovered their *ante-mortem* character, tracking back the oldest signature of human implantology !

The nacre implanted at that time came from mollusc shells. This let imagining the possibility of osteointegration of natural mollusc shells to replace human bone, not only in dentistry but in prosthetics in general. E. Lopez promoted this idea further in the 1980's, demonstrating that natural nacles of some bivalves are not only biocompatible but osteoinductive. These two fascinating discoveries gave rise to tremendous research developments at the interfaces of several scientific disciplines opening the following questionings:

- can we use the shells of other natural species for similar or ameliorated results ? In particular, can we use shell spares from mollusc farming, somehow addressing an answer from mollusc phylogenists, palaeontologist, malacologists, biologists ... ?
- can we detect, by any measurement method, which shell microstructures, structures ... would be the best appropriated to a given medical application, or can we detect already some differences between nacles from various molluscs, a question to physicists and radiation users ?
- is there a way to synthetically reproduce biogenic-like crystals of CaCO_3 , hybridizing organic molecules (either synthetics or extrata from natural shells) with mineral calcium carbonates, involving biomineralisation and structural determination works ?
- can we produce nacre-like bulks or cover prostheses with aragonite layers and implant them, a challenging task for material science, chirurgic and medicine ?

We will try to illustrate some of the actual achievements in these directions. How are we able to deposit nacre-like layers on titanium substrates, how we can modify them using incorporation of molecules and biomolecules, how nacles are different from different species, how land-snail farming and selection can modify shells textures, how texture patterns reproduce mollusc phylogeny and offers character analysis to link ancestral species ... in all these parts the x-ray characterisation tools and modern Combined Analyses will be highlighted.