

# APPLICATION SHEET

Biomedicals – DMA EPLEXOR®

## Microstructures and Dynamic Mechanical Properties of Bones and Implants

### The Trabeculae Bone System – Biomechanical Aspects

DMA is a powerful method for the determination of elastic and viscous properties of polymers, ceramics, composites and food, but also biomechanical materials like bones as well as artificial bone substitutes or implants.

Meanwhile, biological investigations start to determine the elastic-viscous properties of human skeletons or bones. One objective is a better understanding of osteoporosis.

Osteoporosis is no longer a dilute illness of the human skeletal system. It can develop to a painful burden for human life.

To get a better insight into the dynamic properties of the complex bone structures, DMA investigations on especially

prepared trabeculae bone systems of bovine (in this case calf) were carried out.

The first investigations were carried out with low static and dynamic deformation in order to avoid irreversible changes, e.g., due to breakage of micro levels.

Generally, we assume that the surroundings of the in-vivo bone systems are very close to a wet system.

Figure 1 demonstrates the preparation. In a first step, a rectangular prism was cut from the trabeculae region which was divided into two cubes with approximately identical dimensions with respect to the lumbar spine.

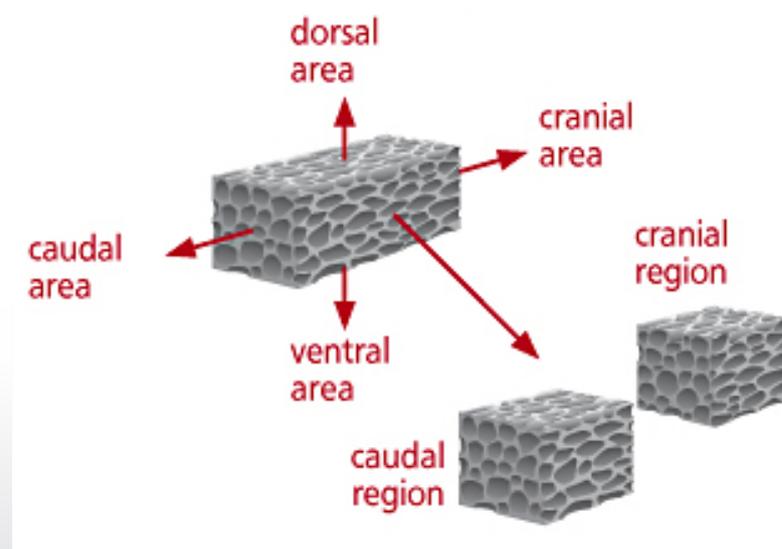


Fig. 1. Preparation of the samples taken from bovine

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In order to obtain “wet” samples, the “cubes” were stored in ethyl alcohol. Therefore, the pores in the bone material were filled with the liquid.

The bone behaves like a sponge which is soft in the wet state and becomes stiff in the dry state. A quite reasonable

explanation could be that the liquid in the collagen fibrillas of the trabeculae structure is removed by evaporating effects during the drying period. This causes an increase in the elastic modulus.

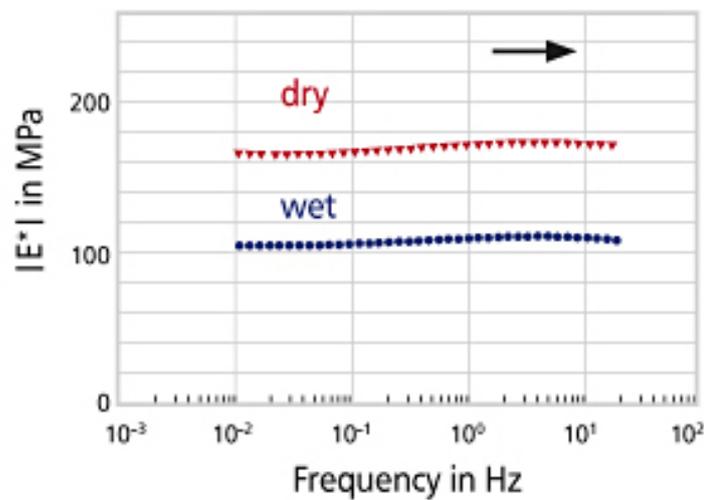


Fig. 2. Complex modulus  $E^*$  – comparison of the wet and dry bone systems