LIFE SCIENCE
MEDICAL BIOLOGY

This volume of SPring-8 Research Frontiers contains three contributions from different medical fields, which all involves new approaches for advancing medical biology.

The study carried out by Hatta was aimed at clarifying the nature of the lipids in the stratum corneum of the skin. This thin top layer of skin is important in that it not only provides protection to our bodies against various undesirable substances in the environment but also provides a barrier that prevents the evaporation of water. Failures in the protection/barrier mechanism immediately lead to skin diseases and infections. The protection mechanism is also relevant to transdermal drug delivery, which is thought to be an ideal method of drug administration in humans. These functions of the stratum corneum are mainly supported by lipid layers between elongated corneocyte cells. Two parameters characterize the structure of lipid layers: one is the periodicity of the stacking of layers, and the other the lateral packing of lipid chains in the plane of a lipid layer. In the mammalian stratum corneum, two types of lipid with different stacking (lamellar) periodicities have been identified. Moreover, two types of lateral packing, namely, hexagonal and orthorhombic, have been identified at room temperature. However, the correlation between these two parameters was not clear. Hatta and his colleagues used X-ray diffraction and recorded small- and wide-angle data simultaneously. By changing the temperature and making a two-dimensional map of the diffraction data versus temperature, they identified correspondence between the two parameters, that is, a long lamellar periodicity with hexagonal packing and a short periodicity with orthorhombic packing.

Matsumoto's study visualized a network of blood vessels in cortical bone. Adequate blood flow is indispensable to maintain healthy bone. High-resolution X-ray tomography technique was employed to obtain the three-dimensional structure of the network. By making use of the monochromatic nature of X-rays at SPring-8, a quantitative measurement of hydroxyapatite density was possible. The effects of disuse on cortical bone was also studied, and a regression of the vascular network was found.

Torikoshi and his colleagues designed an X-ray collimator for MRT (microbeam radiation therapy) experiments. MRT is a new concept in radiation therapy. It uses finely collimated planar beams which were hypothesized to be just as effective as uniform beams for destroying tumor cells but not as damaging to normal cells. In order to test this hypothesis in experiments on animals and cultured cells, it is necessary to make a collimator for high-energy X-rays (above 100 keV) with tens of slits with a width of 25 microns. Torikoshi *et al.* designed a collimator that was made of alternative stacks of tungsten and polymer sheets. It was manufactured by a company that specializes in making grids commonly used in radiography at hospitals. As a result, it is now possible to conduct studies on MRT at SPring-8, and other groups are also using this collimator.

These three studies are all very different in terms of their techniques and the applications in medical fields, showing the diversity and wide range of medical applications studied at SPring-8.

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