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Calcite Microcrystals in the Pineal Gland of the Human Brain: First Physical and Chemical Studies

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A new form of biomineralization has been studied in the pineal gland of the human brain. It consists of small crystals that are less than 20 μm in length and that are completely distinct from the often observed mulberry-type hydroxyapatite concretions. A special procedure was developed for isolation of the crystals from the organic matter in the pineal gland. Cubic, hexagonal, and cylindrical morphologies have been identified using scanning electron microscopy. The crystal edges were sharp whereas their surfaces were very rough. Energy dispersive spectroscopy showed that the crystals contained only the elements calcium, carbon, and oxygen. Selected area electron diffraction and near infrared Raman spectroscopy established that the crystals were calcite. With the exception of the otoconia structure of the inner ear, this is the only known nonpathological occurrence of calcite in the human body. The calcite microcrystals are probably responsible for the previously observed second harmonic generation in pineal tissue sections. The complex texture structure of the microcrystals may lead to crystallographic symmetry breaking and possible piezoelectricity, as is the case with otoconia. It is believed that the presence of two different crystalline compounds in the pineal gland is biologically significant, suggesting two entirely different mechanisms of formation and biological functions. Studies directed toward the elucidation of the formation and functions, and possible nonthermal interaction with external electromagnetic fields are currently in progress. Bioelectromagnetics 23:488–495, 2002.

Key words: microcrystals; second harmonic generation; piezoelectricity; scanning electron microscopy

INTRODUCTION

The pineal gland is a neuroendocrine transducer that converts a neuronal signal into an endocrine output. The neural signal originates in the suprachiasmatic nuclei of the hypothalamus [Reiter, 1991]. The pineal gland is located close to the anatomical center of the human brain, near the third ventricle, and between the superior colliculi. The pineal gland is a highly active organ that secretes a number of important products, the best known of which is melatonin. It has a several important physiological effects that have been studied by a large number of researchers. Among recent reviews are works by Reiter [1991], Karasek [1999], and Pevet [2000].

Pineal calcifications have been found in numerous animals and in humans. They have been given numerous names in the literature, including corpora arenacea, acervuli, psammoma bodies, and brain sand [Welsh, 1985; Vigh et al., 1998]. Two major forms of pineal calcifications have been observed: (i) polycrystalline complexes with dimensions of the order of hundreds of micrometers, often called mulberry-like structures or concretions [Vigh et al., 1998], and (ii) small, well defined crystals having long dimensions of the order of 10–20 μm [Lang et al., 1996]. The mulberry-like structures consist of a mineral component, hydroxyapatite, and protein and glycoprotein organic components

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