Raman-Spectroscopy and Micro-Radiography of Metastatic Vertebral Bone Tissue

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The focus of the present thesis is the spine-bone, affected by metastatic cancer. With todays methods, skeletal metastasis is usually diagnosed at a very late stage, mostly not until the patient shows first symptoms, such as back-pain for example. Spoken in numbers, 30-75% of the bone is destroyed before an osteloytic lesion is detectable. Further, today it is only possible to detect such disease by performing biopsy. And for clinical evaluation of fracture risk in metastatic vertebrae, finite element analysis (FEA) is used. With recent indentation measurements, it remains currently unclear if composition and especially degree of mineralization is altered in blastic and lytic defects.
Therefore, the goal of the present thesis is to detect differences between the latter defects, which lead to a better finite elements analysis (FEA) or even further, to find concepts for detecting metastasis by optical methods. By this opportunity we further compare the results of every method, so we can verify the methods with each other.
One speaks about metastasis, when the tumor-cells could spread in another region of a body (malignant tumor, i.e. cancer). Usually, cancer is initially not developed in bone, the primary tumor is in another organ, for example the breast, kidney, lung or prostate and then spreads into the bone. The latter is called skeletal metastasis, it is the third most common site of metastatic cancer and it affects up to 65% of breast cancer patients. It can result in pain, deformity, loss of mobility and/or paralysis.
In the present study, 14 necropsies embedded in PMMA from 12 different donors were used. First Raman-spectroscopy was performed to gain information about the composition of the tissue. Later micro-radiography was executed to gain information about the mineralization. At the end the results were compared to the mechanical information gained from micro-indentation.
When comparing the different applied techniques, no direct correlation could be detected. Thus, further examinations have to be done. Specially the specific peaks of the Raman-spectra have to be better characterized. For this the best would be if pure materials (e.g pure phosphate) could be examined with Raman-spectroscopy. In other words, phantom for cross-calibration are needed. On the other hand, the data-processing has to be more sensitive to distinguish the overlapping Raman-bands. One possible strategy to realize this is to analyze the derivative or second-derivative of the spectra instead of just analyzing the peaks.

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