Micro-morphological Analysis Towards an Enhanced Diagnosis of Osteomyelitic Bone

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Osteomyelitis is a bacterial infection that has the potential to affect bone microstructure. During the excision procedure for osteomyelitic bone, the surgeons categorize the affected region into three distinct zones: infected, transition, and healthy bone. The categorization is based upon visual and tactile examination and relies upon the surgeon's experience. To understand the variations in different zones, particularly the transition and healthy zones, micro x-ray computed tomography (micro-CT) was used to characterize the micro-structure to determine whether quantifiable differences existed. The mentor provided specimen suitable for imaging with micro-CT at a 4x resolution (~4.1-4.4 μm/pixel) from five pairs of healthy and transition bones from four different patients. The researcher developed 3D reconstructed models of the bone specimen based upon the micro-CT images. These 3D models were utilized in ImageJ to perform quantitative analysis of the micro-structure. The hypotheses of this project were: (1) the transition and healthy bone are micro-structurally different and (2) random samples from the same zone are micro-structurally same. These hypotheses were tested for the following parameters: bone trabeculae thickness and pore size. The test rejected second hypothesis showing the heterogeneity within the bone. Thus, all the data was pooled to make a population. The population means were tested using ANOVA which then confirmed the first hypothesis. The results showed that for some patients, there was likely bone remodeling within the transition zone. The results also show that additional complementary characterization is needed for developing reliable autonomous diagnostic techniques for infected bones.

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