284. A NOVEL COMBINATION OF BONE MICRO-ARCHITECTURE DESCRIPTORS FOR THE IDENTIFICATION OF OSTEOARTHRITIS

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Background: The relationship between knee osteoarthritis (OA) progression and changes in subchondral tibial bone structure has recently been recognized and various texture descriptors have been proposed to detect early stages of OA. However the application of such algorithms is largely dependent on the region of interest (ROI) selected within the subchondral bone area. Therefore, the appropriate selection of ROIs plays a crucial role for the significance of the analysis. Based on our previous work, the present study aims to a) investigate the potential of a combined bone micro architecture algorithm (BMA) as an efficient alternative to established OA descriptors, and b) to define the most significant ROIs for OA discrimination.
Methods: 89 left and 64 right knee joint radiographs of Caucasian females were available, 66 cases and 86 controls. In contrast to our prior work which was limited to proximal tibia, the additional (and novel) effort is to investigate two regions in both condyles of the distal femur. The selected area of the proximal tibia involved a matrix of 3x8 ROIs, whereas a 2×2 matrix was defined for each condyle of the distal femur. Bone Structure Value (BSV) and Shannon Entropy (SE) were calculated for each of the 32 ROIs, respectively. Based on these 64 variables, combinations of ROIs, both individually and in the context of other features and their descriptors, were systematically investigated using statistical and machine learning methods to identify the best performance for discrimination between case and controls.
Results: In addition to the tibial changes, our results indicate that OA is also affecting the subchondral bone structure in femur condyles. By combining the BSV and SE, the odds ratio increased significantly from 3.08 (95% CI: 1.78–5.30) to 14.82 (95% CI: 6.69–32.83) when using 15 features, and to 39.75 (95% CI: 15.41–102.51) based on 10 features. By using the selected 10 features the accuracy was found to be 0.86, reflecting a significant improvement compared to the accuracy achieved when calculating a single mean value for the 3×8 ROIs of the proximal tibia alone (0.62 vs. 0.86).
Conclusion: The combination of subchondral ROIs of both femur condyles and the proximal tibia clearly improve the discrimination between OA cases and controls. The model can further be improved by incorporating shape descriptors and a full automation, exploiting recent advances in segmentation and/or landmarking. Moreover, our approach may also be of interest for alternative fields of research, in particular the investigation of BMA descriptors in osteoporosis.
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