Characterization of trabecular bone structure at 9.4T by texture analysis : comparison between arthrosis and osteoporosis

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Introduction

In this study we wanted to evaluate 9.4T MR images texture modification and degradation caused by different levels of compression (16bits Bruker Images, then compression to 12, 10, 8, 6 and 4bits) for the discrimination between osteoporotic and arthrotic human bone samples. On the contrary to arthrosis, osteoporosis is characterized by thinner bone trabeculae or rarefaction which gives two different textures on MR images.

Method

12 defatted human femur samples were used in the study (6 osteoporotic and 6 arthrotic). The acquisitions were performed on a Biospec 9.4T horizontal magnet (Bruker, Wissembourg, France) using a home made loop gap coil. 2D images were obtained using a Flash sequence with the following parameters (TR= 50ms, TE=4.2ms, matrix size = 256*256 and FOV=10*10 cm). The resolution was 21*21*160 µm for an acquisition time of 25 min. One region of interest (ROI) was selected in a slice , normalized and then analyzed with four grey levels texture analysis methods (histogram, cooccurrence, gradient and runlength matrices) using a home made software. Each sample was then characterized by a texture profile computed with the different texture parameters. Correspondence Factorial Analysis (CFA) and Hierarchical Ascending Classification (HAC) were performed to discriminate those 12 profiles.

Results

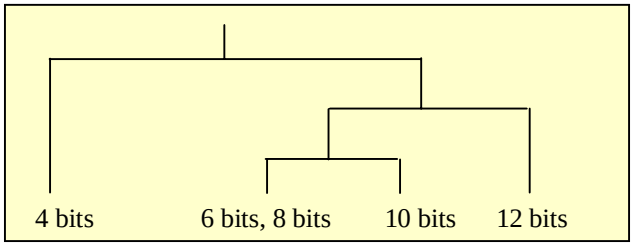

***Figure 1** : Images texture discrimination after different image normalization levels*

Compression level	Well-classified ROI
4 bits	58%
6 bits	42%
8 bits	**75%**
10 bits	67%
12 bits	67%

***Table 1** : Two-classes classification (arthrotic/osteoporot after different image normalization levels*

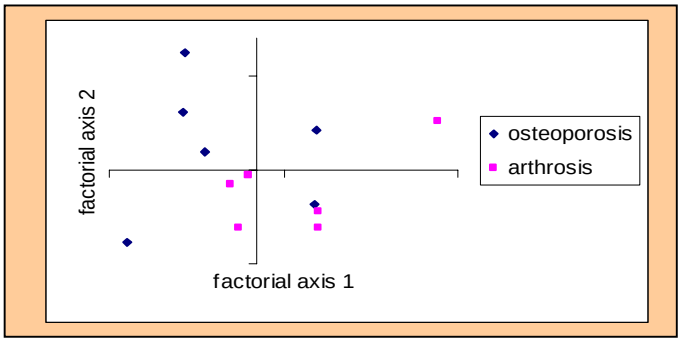

***Figure 2** : Osteoporotic and arthrotic samples discrimination on 8 bits MR images*

The dendrogramm on figure 1 shows that there is a clear discrimination between texture profiles if different MR image compression levels are used both for osteoporotic and arthritic samples. The two-classes classification on all samples gives the best results after a normalization on 8 bits (table1). The CFA presented on figure 2 underlines two classes (separated with factorial axis 1) which gives 75% of well-classified ROI (arthritic or osteoporotic) with 3 misclassified (figure 2).

Conclusion

Texture analysis is an efficient quantitative analysis technique to characterize pathological trabecular bone structure. Care must be taken to normalize all the images before analysis. We are actually extending this study to 3D MR bone images (21µm*21µm*21µm) at 9.4 T to correlate our grey level texture analysis with structural parameters analysis (trabeculae thickness, trabeculae number, trabeculae spacing..) from CTscan images at the same resolution.