Can bone microstructure predict fracture predisposition? Towards *in vivo* analysis.

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Vibrational spectroscopy has proven itself to be a key technique in significantly advancing our fundamental understanding of mineralised tissues, the relationship between microstructure and fracture resistance, and globally important orthopaedic diseases. We previously reported the first use of specular reflectance FTIR microspectroscopy in conjunction with discriminant analysis to investigate the microstructure of third metatarsal bone samples from 30 young Thoroughbred horses. These animals consisted of 10 newborn foals, 10 five month old foals and 10 two year old horses with known training histories. Results revealed inherent microstructural differences between fracture predisposition and control sites. The purpose of this work was to replicate the FTIR study using Raman microspectroscopy, which lends itself to future development for *in vivo* applications, since it can be applied to samples of bone without any prior preparation. While there were some differences in the results obtained by Raman and FTIR microspectroscopy, the overall conclusions were identical. The Raman results are in agreement with our previous findings that there appears to be a chemical basis for fracture predisposition irrespective of athletic activity and that individuals with abnormal bone microstructure may be identified long before bone defects become clinically evident.

Discriminant analysis plots of the 2 year old horses illustrating clear microstructural differences between fracture predisposition and control sites (left: FTIR data from previous study, right: Raman data from this study).
[1 = lateral parasagittal groove, 2 = medial parasagittal groove, 3 = medial condylar surface]