Issues in interstudy comparisons of bone microarchitecture

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Tassani and Perilli [1] raised an interesting technical question in micro computed tomography (micro-CT) studies. We agree with them that characteristics of the scanned volume might also contribute to differences in obtained data, which should be also borne in mind when comparing different studies. Indeed, various micro-CT studies use a number of different approaches, various scanning resolutions, different segmentation and thresholding procedures and different shape and size of volumes of interest (VOI). In particular, the nominal resolution and voxel size varied significantly among studies, and the effects of that variability on bone microarchitectural parameters have been recognised already [2]. In contrast, variability in VOI location, shape and size is often not well appreciated, although significant differences were found in primate bones after varying these parameters [3]. Hitherto, there has been no serious evaluation of the relative benefits (or risks) of considering a particular regular geometric VOI (cylindrical, spheric, cubic) vs. manually marked (adapted) scanning zone. Yet, certain advantages of using “adapted VOIs” were suggested, as simple geometric VOI shapes cannot encompass all the bone tissue within a desired zone [4].

In our micro-CT study on the human femoral neck’s trabecular bone in osteoarthritic patients vs. healthy controls [5], the entire femoral neck was subdivided into inferomedial and superolateral halves. Segmentation was performed semiautomatically, meaning that we manually marked the complete cancellous region of interest (ROI) on every 25th CT slice, followed by interpolation of the marked ROI on all other slices

using the Morph function of the micro-CT programme (Scanco Medical, Switzerland). Therefore, a VOI with a thickness of 3.6 mm was obtained based on a total of 200 slices per specimen and was further analysed quantitatively. Dimensions of an adapted VOI for inferomedial or superolateral neck were approximately 1 cm³. In terms of histomorphometry, 3.6 mm of thickness provides at least four or five trabecular layers that, together with a 1-cm³ volume, should be representative of the analysed region. We understand from Tassani and Perilli [1] that apart from the values of degree of anisotropy, additional data such as H1, H2, H3 and determination coefficients might be useful, but H values were not recorded in our study, whereas the coefficient of determination is not provided in Scanco micro-CT evaluation printouts.

However, in addition to methodological differences, interstudy comparisons should carefully consider exact positions of examined bone sites (e.g. femoral head [6] vs. subregions of the femoral neck [5]), as a substantial amount of data suggests intersite differences in bone structure [7, 8].

In summary, as micro-CT findings reflect biological differences together with methodological imprints, findings from various studies should always be compared with caution, giving due consideration to methodological and technical differences in data acquisition/analysis. However, comparison of specimens within a single study might maintain reliability as long as specimens are analysed in a consistent manner.

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