

Title: Uniaxial and multiaxial fatigue life prediction of the trabecular bone based on physiological loading: a comparative study

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Abstract: Fatigue assessment of the trabecular bone has been developed to give a better understanding of bone properties. While most fatigue studies are relying on uniaxial compressive load as the method of assessment, in various cases details are missing, or the uniaxial results are not very realistic. In this paper, the effect of three different load histories from physiological loading applied on the trabecular bone were studied in order to predict the first failure surface and the fatigue lifetime. The fatigue behaviour of the trabecular bone under uniaxial load was compared to that of multiaxial load using a finite element simulation. The plastic strain was found localized at the trabecular structure under multiaxial load. On average, applying multiaxial loads reduced more than five times the fatigue life of the trabecular bone. The results provide evidence that multiaxial loading is dominated in the low cycle fatigue in contrast to the uniaxial one. Both bone volume fraction and structural model index were best predictors of failure ($p < 0.05$) in fatigue for both types of loading, whilst uniaxial loading has indicated better values in most cases.