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THE IDEA THAT STRESS INDUCED FLUID FLOW CAN PROVIDE SUFFICIENT NUTRIENT TRANSPORT IN OSTEONS COULD BE AN ILLUSION

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#### Abstract

It was argued from the results of marker migration experiments that mechanical loading of cortical bone in vivo increases marker penetration into the osteon. However, it is not obvious that it is result of passive stress induced fluid flow, as Knothe Tate and Niederer assume (1998), or of stress induced stimulation of an existing active transport process.

In fact, the ratio between the dilated lacunar volume and its reference volume is smaller than order of 0.0001. This means that the number of cycles necessary to create a concentration of nutrients within lacunae of the same order as in blood should be of order of 10 000. But at normal physiologic loading such a number of cycles would an elapsed time period of order of 10 000 sec. However according the experimental study described by Wang et al. (2000) the increase of tracer penetration was fixed after only 20 seconds at 1Hz cyclic loading immediately after injection of horseradish peroxidase solution.

In the present study, to avoid the problems with the unknown canalicular geometry and fluid viscosity we did analysis for dilatation of an empty lacuna, which, from mechanical point of view, represents an upper limit for dilatation of a real fluid filled lacuna. Although the calculated value of the rate of delivery of glucose is 3 orders less than the suspected value of glucose necessary to sustain osteocyte vitality. Result strongly suggests that the stress induced fluid flow within the lacunar-canalicular system should be ineffective as the nutrient transport mechanism. Perhaps an active transport mechanism should be involved.