IN VITRO SODIUM FLUORIDE EXPOSURE DECREASES STRENGTH AND INCREASES DUCTILITY OF MOUSE FEMORA

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Introduction: Fluoride has been advocated for the treatment of osteoporosis because of its anabolic effect on osteoblasts. Fluoride can also alter bone mineral structure, and several investigators have inferred that the alteration in bone mineral causes a reduction in bone tissue strength that can negate the positive effects of increased formation [1-3]. However, the direct effects of fluoride-related mineral alteration on the mechanical properties of bone are largely unknown. Walsh and Guzelsu [4] reported that bone strength was reduced by in vitro exposure to sodium fluoride, although a lack of physiological buffering may have confounded their findings [5]. In addition, experimental studies have not led to a consensus on the effects of fluoride in vivo, perhaps because of differences in testing techniques between studies. It has been shown that whole bone torsional and bending tests may produce different relative findings [6]. Our objective was to investigate the effects of in vitro sodium fluoride exposure on whole bone properties. We asked: 1) Does in vitro sodium fluoride exposure affect the mechanical properties of mouse femora? 2) Is this effect dependent on the presence or absence of physiological buffers? 3) Is this effect different for torsional and bending loading?

Methods: Sixty femora from 30 C57BL/6 female mice were obtained at 10 weeks of age and assigned to one of four treatment groups: A) Control-Buffered, B) Control-Non Buffered; C) Fluoride-Buffered; D) Fluoride-Non Buffered. The buffered solution was standard phosphate buffered saline with calcium chloride added to achieve a physiological concentration of calcium [5]; the non-buffered solution was distilled water only. Sodium fluoride was added to groups C and D to a concentration of 1.5 M. All bones were flushed of marrow and cleaned for 24 hours using a mild detergent solution [4], a step buffering had a modest effect on ultimate torque and rotation. This finding further illustrates the importance of proper buffering had a modest effect on ultimate torque and rotation. This finding further illustrates the importance of proper

Discussion: 1) Fluoride exposure in vitro caused a large decrease in bone stiffness and strength and a large increase in ductility (deformation until failure). If the nature of the alteration in mineral structure mimics that seen in vivo, these findings suggest that incorporation of fluoride into bone mineral causes a substantial degradation of mechanical properties. This degradation may inherently limit the efficacy of fluoride therapies in preventing osteoporotic fracture. 2) Lack of buffering had a modest effect on ultimate torque and rotation. This finding further illustrates the importance of proper buffering for handling of bone specimens [5]. Nevertheless, buffering did not obviate the negative effect of fluoride. 3) Fluoride exposure caused a larger reduction in torsional strength than bending strength, suggesting that torsional testing may provide a more sensitive assay for detecting the effects of fluoride treatment in experimental studies.

Acknowledgments: Washington University Medical School.