

Validation of Bone Shock Absorption in the Pediatric Population – A Pilot Study
McKenzie L. Nelson¹, Cyndy Cox², Lorena Altman², Amit Bhattacharya², Halley Wasserman³

*University of Cincinnati College of Medicine*¹, *University of Cincinnati College of Medicine Department of Environmental Health*², *Cincinnati Children's Hospital Department of Endocrinology*³

Introduction: Adult bone health is established during childhood. Inadequate bone mass acquisition during childhood is associated with an increased lifetime risk for fractures. Currently, dual energy x-ray absorptiometry (DXA) is used clinically to measure bone mineral density (BMD), but it is not sensitive enough to quantify bone fragility in children. Bone Shock Absorption (BSA) measures damping, or the ability of bone to absorb external forces; higher damping indicates a lower probability of fracture or increased resistance to fracture. BSA has been validated in postmenopausal women diagnosed with osteoporosis by DXA and differentiated those who previously fractured from those who had not. It has not been tested in children but offers an alternative non-invasive method to assess the ability of bone to resist fracture in children with bone disease.

Hypotheses:

- 1) Pre-pubertal children can perform the BSA heel-strike technique
- 2) BSA can distinguish between children with Osteogenesis Imperfecta (OI) Type I and matched controls.

Methods: 3 children with OI and 6 age, sex and race matched controls completed BSA. BSA was performed by each subject using the heel-strike technique with accelerometers attached to the tibial tuberosity, lateral femoral epicondyle, and 7th thoracic vertebra. Custom software was used to analyze the frequency response functions (FRFs) to calculate damping. Damping at each anatomical site was determined from the first peak in the FRF, averaged from five best trials. BMD was measured by lumbar spine DXA.

Results: Damping at the lateral femoral epicondyle was higher for controls than OI. OI patients treated with bisphosphonate therapy have lower damping than the untreated OI patient. No correlation was found between damping and bone density.

Conclusion: Children were able to properly perform the technique for BSA. Damping values were consistent across anatomical sites for each subject, providing validation of results. BMD and damping were not correlated, indicating that BSA gives additional information about bone health. Finally, differences exist in damping of children with OI compared to healthy controls and between OI cases with different fracture rates, but larger sample sizes are needed to determine if this is statistically significant.

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