

Δ The Effect of Cigarette Smoke Versus Vaporized Nicotine on Healing of a Rat Femur

Jacqueline Tucker, BS; Andrew J. McCullen, BA; Zachary Adam Koroneos, BS; Hwa Bok Wee, PhD; Aman Dhawan, MD; Gregory S. Lewis, PhD; Matthew Robert Garner, MD Penn State College of Medicine, Hershey, PA, United States

Purpose: Our objective was to characterize and compare the biomechanical, radiologic, and histologic changes that occur with femur fracture repair in an established Wistar rat model with vaporized nicotine (“vaping”), combusted tobacco, and controls.

Methods: 45 adult male Wistar rats were randomly divided into three cohorts (cigarette, vaping, and control), consisting of 15 rats each. Rats were exposed to either two unfiltered University of Kentucky 3R4F research cigarettes daily, an equivalent dose of vaporized nicotine, or placed into containment tubes for the same period of time as the exposures, 6 days a week. All rats received their daily exposures for 4 weeks prior to surgery where femurs were fractured and then repaired using Kirschner wire. Following surgery, the rats received 4 additional weeks of exposure. After sacrifice, femurs were harvested and imaged using micro-CT scans. Ten specimens from each cohort underwent biomechanical testing using a torsional, rotation-to-failure model. Remaining samples were sent for histologic analysis and graded and evaluated for union, spongiosa, compacta, inflammation, neovascularization, and necrosis.

Results: 42 rats completed 4 weeks of exposure after fracture and fixation. Micro-CT images revealed a significant difference between groups in mean bone mineral density (BMD) of mature bone ($P = 0.05$) with vaping having the highest value. Direct comparison of vaping and smoking groups for mean BMD of mature bone demonstrates increased density in the vaping group ($P = 0.04$). No significant difference between the three groups was identified for total callus volume ($P = 0.14$), total volume of immature bone ($P = 0.15$), mean BMD of immature bone ($P = 0.135$), or volume of mature bone ($P = 0.12$). Biomechanical testing revealed no significant difference with max torque ($P = 0.31$) or group torsional stiffness ($P = 0.92$) between the three groups. The smoking group had the highest maximum torque followed by the control and then the vaping group (0.24 Nm, 0.21 Nm, 0.20 Nm, respectively). For histology, χ^2 analysis showed no significant difference in any category.

Conclusion: This study compared smoking cigarettes, vaping, and a control group by using CT scans, torsion testing, and histology. This animal fracture repair model found significance only in mean BMD of mature bone. No significant differences were seen in remaining CT imaging variables, biomechanical testing, or histology between the three groups. Larger studies must be completed for further understanding.

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See the meeting app for complete listing of authors' disclosure information. Schedule and presenters subject to change.