Abstract of proposed student project (1 page limit. This should mirror the aims page of a grant and CLEARLY indicate the student's role.)

INTRODUCTION: Limb deformity correction in small animals is a complex and technically demanding procedure, which involves creating osteotomies and stabilization of bone fragments in the appropriate orientation. There are two broad categories of implants that can be used: external skeletal fixation and internal skeletal fixation (such as bone plates and screws). External skeletal fixation consists of bone pins that are inserted through the skin into bone, and connecting elements that secure to the bone pins. The main advantage of external skeletal fixation is that post-operative adjustments can be made to the limb alignment. This feature is desirable with limb deformities as it can be difficult to predict the optimal limb alignment during surgery.

Applying and external fixator is more time consuming and, arguably, more difficult than applying internal fixation Because pins are placed through the skin, the underlying bone is not completely visible, and most pins are placed in a 'blind' fashion. Intraoperative x-ray imaging (fluoroscopy) is therefore commonly used during the placement of these pins, but the additional steps to acquire the images contributes to prolonged surgical times and radiation exposure to the animal and personnel.

Recently, 3D printing has been used to facilitate limb deformity correction, including the use of customized cutting and alignment guides. These guides, however, are designed for application directly onto bone surfaces that are exposed with an open surgical approach. We believe similar methodology can be developed for external skeletal fixation where the guides sit on the surfaces of the skin. The goal of this study is to develop and assess the accuracy of customized 3D printed guides for external skeletal fixation.

METHODS: Computed tomographic scans of the forelimbs of medium sized cadaver dogs (n=5) will be acquired. Digital models of the forelimbs including the skin and underlying bone will be created. We will develop customized molds that conform perfectly to the skin surfaces of the forelimb and elbow; this mold will feature several cylindrical sleeves that will guide bone pin placement. The mold will be designed such that it can be removed easily following application of the bone pins. Surgical time will be recorded. Difficulty of guide application and pin placement will be subjectively quantified on a Likert scale. Post-operative CT scans will be acquired, and true pin placement will be compared with the planned pin placement.

Data will be summarized using descriptive statistics. This is a 'proof-of-concept' study.

ANTICIPATED RESULTS: We anticipate that guide and pin placement will be rapid and easy to perform. We also hypothesize than pin placement will be within 2 degrees and 1 mm from the digitally planned position.

FVSP Student involvement: Learning software and 3D printing techniques, developing guides, data collection, manuscript preparation with targeting publication as first author in peer-reviewed veterinary journal.