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EVALUATION OF 3D-PRINTED BONE MODEL, CUSTOMIZED SAW GUIDE AND JIG FOR ANTEBRACHIAL ANGULAR LIMB DEFORMITY SURGICAL CORRECTION IN DOGS

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With currently available advanced imaging modalities, veterinary orthopaedic surgeons can precisely plan and execute corrective osteotomy. In theory, the surgeon can outline an accurate, ideal corrective osteotomy plan preoperatively to align all bone deformities. In reality, however, the standard tools and techniques used by the surgeon can substantially limit the ability to reliably and consistently reproduce the ideal preoperative plan at the time of osteotomy. Three-dimensional (3D) printing has been used in various methods for both human and veterinary medicine and surgery. 3D planning obtained from computed tomography (CT) with computer-aided design (CAD) software allows the creation of an accurate bone model and surgical guides to use during the surgery.

Accurate preoperative planning using 3D bone models have increased knowledge of surgical procedures, improved surgeon confidence, and reduced surgical time. During corrective osteotomy the customized saw guide and temporary bone stabilizer (jig), fits onto the bone surface in only one possible configuration, thereby orienting the surgeon to the proper bone location for correct bone excision and next alignment of bone fragments.

The aim of this study was to investigate whether the CT-scan provides sufficiently accurate bone surface information for saw guide and jig development in two dogs with antebrachial angular limb deformity.

First step of work in this study was an image segmentation based on CT scan results to obtain bones 3D model. By using engineering software to work on 3D points mesh, it was possible to plan the insertion of Kirschner wires, delineate the incision line and change the orientation of the bone fragments in 3D environment. Using reverse engineering methods, it was possible to return the position of the bone fragments to their original state with Kirschner wires in their final state, making it possible to design a two-part wire guide and saw blade in the freeform haptic modeling software. This type of approach made it possible to insert the wires at different angles into the bone, cut it, and then insert a guide that acts as an external stabilizer, where the position of the wires is parallel in one plane, which greatly facilitates the intraoperative work of the surgeon. The guidewire models were then made using 3D FDM printing technology from materials certified for blood contact, allowing steam sterilization at 121^{o}C.

The study describes process of designing and manufacturing saw guides and intraoperative jigs with further usage in two surgical cases.