FEASIBILITY OF STANDING ROBOTICS-CONTROLLED CONE BEAM COMPUTED TOMOGRAPHY OF THE DISTAL TARSAL AND PROXIMAL METATARSAL AREA

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Purpose

Equine standing cone beam computed tomography (sCBCT) is a recent modality, with most research focusing on the distal extremity and head.[1,2] This pilot study was intended to determine feasibility for sCBCT of the proximal metatarsal suspensory enthesis.

Methods

Eight horses presented for advanced standing imaging have been subjected, under owner consent, to robotic sCBCT of the distal tarsal/proximal metatarsal area using a patented motion-correction sleeve[3] (fig. 1). Cross hairs were centered on the tarsometatarsal joint. Restraint and imaging protocols were optimized continuously.

Results

Bilateral imaging was performed in 2/8, giving a total of 10 scans performed. An acepromazine-detomidine-morphine cocktail provided adequate sedation in 9/10. Additional blinding and ear-plugging were necessary in 1/10. The optimized protocol included a 210° pulsed acquisition (with 240mm FOV, 120kVp-0.3mA parameters and 0.45mm voxel resolution) and imaged the region from the tarsocrural joint to the middle 3rd metatarsus (fig. 2).

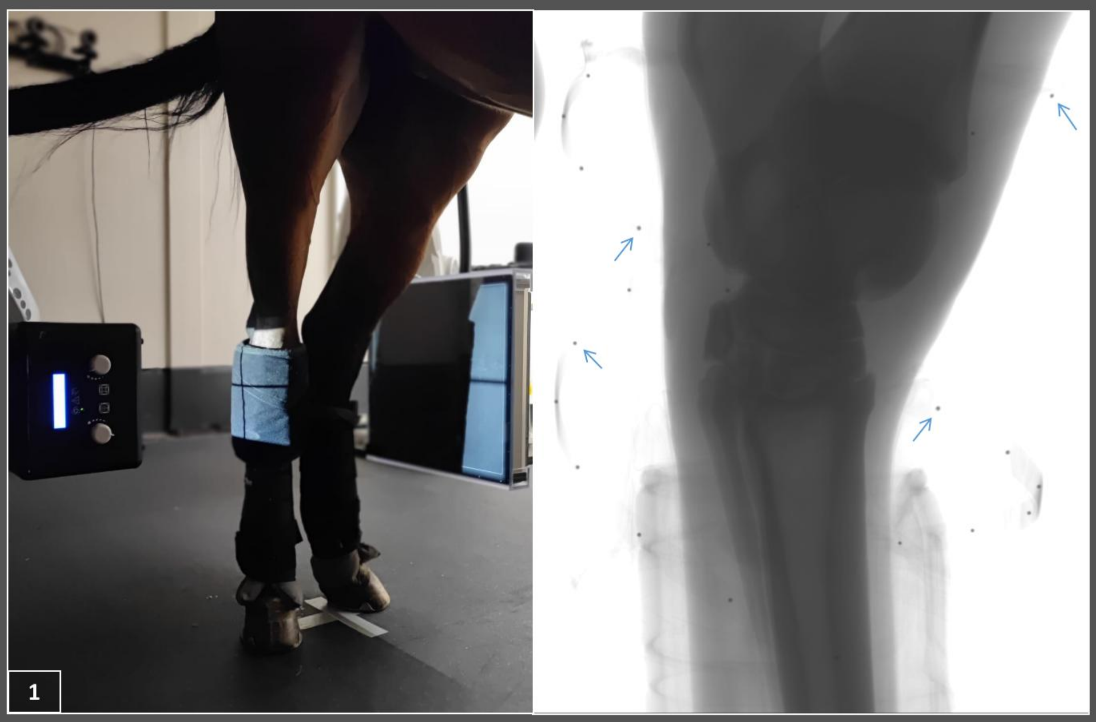
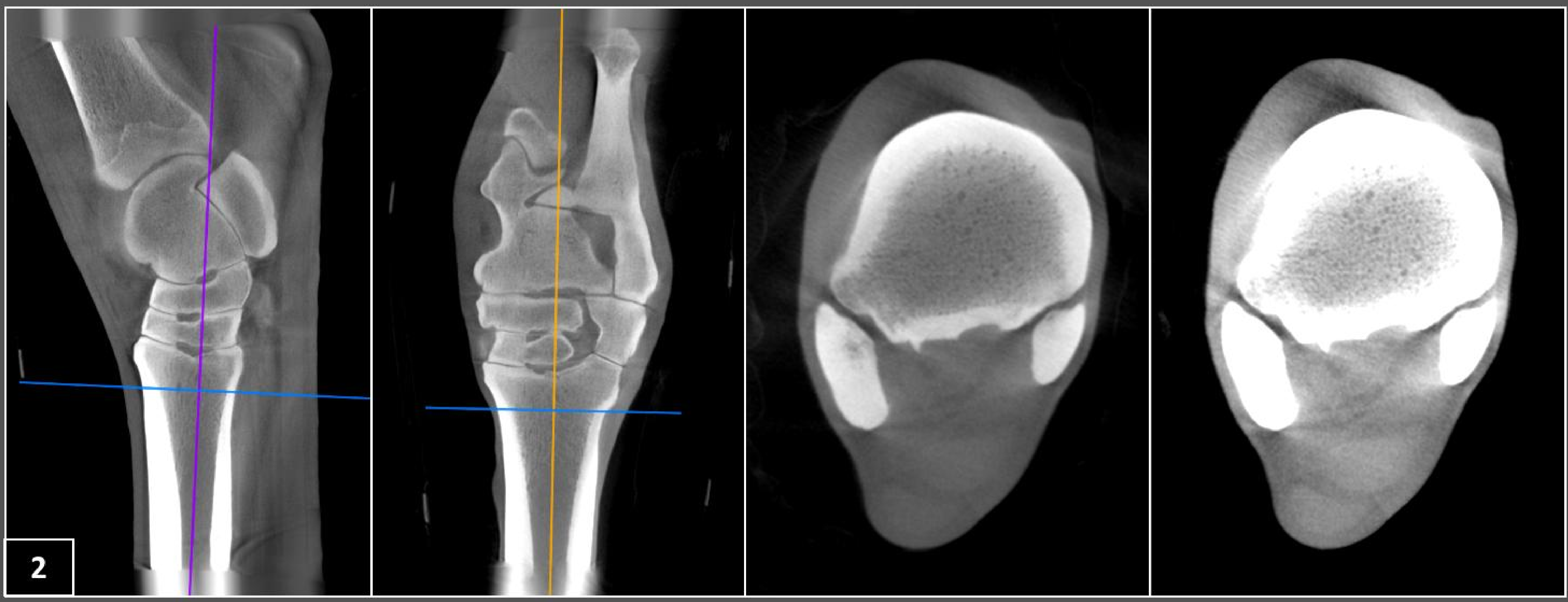


Fig. 1 Set-up *(left)* and fluoroscopic acquisition image *(right)*. Notice the black wrap-around sleeve *(left)* containing 2 strings of metallic beads arranged in a helix *(right, arrows)* enabling 3-dimensional motion-correction through mathematical bead tracking and tracing.



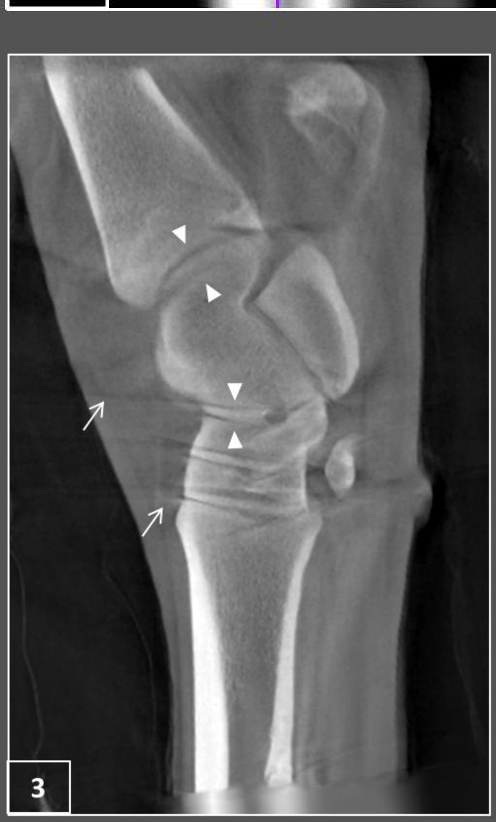


Fig. 2 MPR reconstruction of the proximal metatarsal area in bone *(left)* and soft tissue *(right)* algorithm. Notice the overall high detail of bone microarchitecture *(left)*, but low soft tissue definition *(right)*.

Rescans were performed in 2/10 due to excessive patient movement (fig 3). After retrial, motion correction was successful in 10/10. Post-processing beam-hardening, streak and cone-beam artefacts were most prominent at the distal tarsal joints. Overall image quality was deemed sufficient, with high trabecular and cortical bone detail, but general low soft tissue contrast.

Fig. 3 Sagittal MPR reconstruction of insufficient motion correction. Notice the doubling of joint spaces *(arrowheads)* and increased conspicuity of streaking artefacts *(arrows)*. Bead tracking failure was particularly seen with rotational movement (flexion) of the tarsocrural joint during acquisition.

Conclusion

Standing CBCT is a feasible modality for detailed bone imaging of the proximal metatarsal suspensory enthesis. However, the technique remains susceptible to artefacts and dedicated software was necessary for sufficient image quality.[4] The inherent low soft tissue contrast of CBCT was confirmed[5] and further studies on the feasibility of combined sCBCT and sMRI are needed to fully evaluate diagnostic performances.

1. Stewart HL, et al. Use of cone-beam computed tomography for advanced imaging of the equine patient. Equine Vet J. 2021;53(5):872-85. 2. Curtiss AL, et al. Validation of standing cone beam computed tomography for diagnosing subchondral fetlock pathology in the Thoroughbred racehorse. Equine Vet J. 2021;53:510–23. 3. U.S. Patent No. 11,099,140. 4. Schulze R, et al. Artefacts in CBCT: a review. Dentomaxillofac Radiol. 2011;40(5):265-73. 5. Demehri S, et al. Assessment of image quality in soft tissue and bone visualization tasks for a dedicated extremity cone-beam CT system. Eur Radiol 2015;25, 1742–51.