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EDITORIAL

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Clinical insights: Musculoskeletal injury in the racehorse: What is new?

Musculoskeletal injury (MSI) accounts for significant wastage in the racehorse and represents a major welfare concern for the industry. EVJ remains at the forefront of research advancing the epidemiological, clinical, diagnostic and therapeutic understanding of MSI, with the collective aim of maximising racehorse safety.

'Musculoskeletal injury' covers a near exhaustive list, making comprehensive evaluation impossible in this editorial. Our focus, therefore, will be reporting clinically relevant papers, published within the last 2 years, directed at advancing the understanding of disease processes, novel diagnostics and treatment modalities from the carpus to the fetlock in the racehorse.

It is well established that most fractures in the racehorse result from an imbalance between microdamage and repair due to repeated, cyclic loading. A 2020 study investigating a novel in vitro fatigue testing method demonstrated the importance of high speeds and cyclic fatigue in the development of subchondral bone injury.[1] Another recent study evaluating subchondral bone disease in the fetlock reported the relationships between training and accumulated damage.[2] This post-mortem cross-sectional study quantified calcified cartilage and subchondral bone microdamage underlying the articular surface of the palmar aspect of the medial metacarpal condyle and parasagittal groove in 46 Thoroughbred (TB) racehorses at different stages of training using micro-CT and light microscopy. Gross articular surface damage was shown to not always be indicative of bone microdamage, with gross evidence of palmar osteochondral disease (POD) being present in only 39% of condyles while microdamage was identified 100% of the time. Microdamage appeared to accumulate with career progression and was more extensive in areas of greater bone volume underlying the parasagittal groove in horses in race training. Independent of age, microdamage levels were shown to be lower in resting horses which is consistent with previous work demonstrating higher levels of subchondral bone remodelling during rest periods. Authors recommended adjusting training to ensure adequate rest periods and/or reducing the intensity and duration of training to prevent the accumulation of microdamage. Additionally, the presence of bone sclerosis was suggested to be representative of localised microdamage, prompting authors to propose training modifications in response to the radiographic identification of sclerotic change. The authors noted that multicollinearity between variables associated with career progression made it difficult to identify specific risk factors.

The prodromal nature of many racehorse injuries is particularly important to consider when medicating joints. Amid increasing awareness that medication may mask early clinical manifestations of fatigue fractures, allowing horses to progress further along the pathological spectrum and increasing the risk of serious injury, a recent longitudinal study evaluated fractures in 1488 TB racehorses receiving intrasynovial medication.[3] The prevalence and type of fracture occurring following medication was studied. Fractures occurred in 6.5% of medicated horses within 56 days (8 weeks) of intrasynovial injection. Within this subgroup 45.8% of fractures were considered serious and 11.5% of horses were subjected to euthanasia due to the severity of the injury. The medicated joint was involved in the fracture 55.7% of the time and 56.4% of horses injured within 56 days of medication were able to return to racing. The fetlock and carpus were overrepresented with distal radial carpal bone fragmentation, dorsoproximal P1 fragmentation and metacarpophalangeal/metatarsophalangeal (MCP/MCT) condylar fractures being the most common injuries reported. Horses receiving 3 or more intrasynovial injections; those being medicated during or before their 2-year-old year; and horses with a decreased interval between medications were more likely to sustain injury. Although the study was limited by its lack of a control non-medicated population and results may have been influenced by the authors' screening policy for prefracture pathology, the description of the extent of premedication imaging was especially interesting. Although 73.9% of horses received diagnostic imaging prior to joint medication, only 29.2% of the injury group were imaged and, notably, only 7.3% underwent imaging specific to the future injury site. Authors concluded that imaging should be undertaken before medicating joints and that mandated premedication imaging, such as that used by The Hong Kong Jockey Club, may reduce fracture risk.

Despite this study alluding to the importance of imaging prior to medicating joints in racehorses, a 2018 retrospective, observational study evaluating osteochondral fragmentation of the dorsoproximal articular surface of the proximal phalanx (P1) in 242 UK racing TB horses highlighted deficiencies in radiography for comprehensive diagnosis of existing injury as confirmed arthroscopically.[4] Researchers determined that dorsoproximal fragmentation of P1 occurred most frequently medially and, in the forelimbs, but that the radiographic predictive value for uniaxial fragmentation was only 73.3% for dorsomedial and 71.9% for dorsolateral fragments. For cases with biaxial fragmentation, radiographs identified both lesions only 32.5% of the time. Authors emphasised the importance of diagnostic arthroscopic examination for racehorses with synovial effusion or lameness localised to the MCP/MTP joint in which radiographic findings are inconclusive.

A reality of TB racing, however, is that economics often influence both diagnostic and therapeutic decision making, meaning that surgery is not always a financially viable option. Research evaluating prognoses for conservative therapies, therefore, can be particularly useful, providing evidence-based rationale for such management in the absence of surgery. Recently, EVJ compared conservative and surgical management for 2 commonly reported racehorse injuries.

The first, a 2020 paper by Ramzan et al[5] challenged the necessity for surgical P1 chip removal in all cases, by comparing nonsurgical and surgical management of metacarpo/metatarsophalangeal dorsal chip fractures in a population of 98 Thoroughbred racehorses. No significant difference was reported between groups in subsequent ability to start at least one race, with 78.6% of conservatively managed horses and 85.7% of surgery horses returning to racing, although race performance indices were not reported. Nonsurgical management was associated with significantly faster returns to racing with median time to first start being 106 vs 203 days for the surgery group. Finally, there was no evidence from clinical examinations or review of intra-articular medication data that nonsurgical management was associated with increased risk of associated ongoing orthopaedic problems. In fact, nonsurgical cases were reported to have less radiographic evidence of arthritic change than surgical cases over the follow-up period (23-3859 days). Assignment to treatment groups in this study was nonrandomised, therefore, results should be interpreted with caution due to the potential for case selection bias.

In another retrospective study by Tallon et al[6] conservative and surgical management of sagittal fractures of the third carpal bone in 47 UK TB racehorses were compared. No statistically significant difference between conservative and surgical groups existed when comparing the proportion of horses returning to racing, although 67% of surgical cases completed at least one race compared to 47% of conservatively managed horses. The median time to first race was comparable for each group but long-term follow-up was not included. Racing Post Ratings (RPR) were reported and demonstrated that surgical horses were significantly more likely to maintain or improve their race performance compared with conservatively managed horses. Despite this being the largest case series of surgically managed sagittal fractures in TB racehorses, the small number of conservatively managed horses and the nonrandomised nature of the treatment group assignment requires caution when interpreting comparisons.

As highlighted by the previous 2 reports, authors often choose different outcome variables to evaluate treatment success in clinical studies of racehorses. In fact, a recent meta-analysis by Wylie et al[7] failed to identify any industry standard for reporting racehorse performance outcome variables. Difficulties in comparative analysis of racehorse studies were highlighted by identification of 117 different outcome measures used in published research. Authors described the pros and cons of these numerous performance measures and cited return to racing, number of starts and days to first start as the most used parameters with a 2-year follow-up period being proposed as optimal. While authors considered that performance indices may improve overall analysis, they were found to be underutilised in research with no universally accepted technique to achieve true objectivity and industry indices were determined to lack independence and transparency. Despite this, as clinicians we are often asked to predict the effect of an injury/treatment on a horse's subsequent performance and not simply if the horse will race again. Prognostically, therefore, it may be helpful to report more information than the binary outcome of 'return to racing'.

While radiographic imaging is often a common starting point in racehorse diagnostics it can be insensitive. Radiographic identification of sagittal fractures of the third carpal bone (C3), for example, is not always straight forward, as highlighted by the Tallon study, where two horses required arthroscopy and two required MRI for diagnosis. Such radiographic insensitivities prompted Ramzan to describe a novel radiographic projection for detection of sagittal slab fractures of the third carpal bone.[8] The modified dorsoproximal lateral-palmarodistal medial oblique (DPrL-PDiMO) view reportedly had superior diagnostic value for the detection of some sagittal fractures in the medial portion of the third carpal bone. In cases of suspected carpal injury in racehorses, the author recommended adding this view to the normal carpal radiographic series.

Although novel techniques can increase radiographic sensitivity, inadequacies in current imaging continue to make advanced predictive diagnostics the Holy Grail with respect to reducing or eliminating musculoskeletal injury. Several recent EVJ papers have investigated the feasibility of targeted novel diagnostic modalities for early identification of common musculoskeletal injuries in the racehorse.

Proximal sesamoid bone (PSB) fractures are the most common fatal MSI in US racehorses. A 2019 cadaver study used micro-CT to identify morphological differences between PSBs of fracture horses and controls.[9] It determined that greater bone volume fraction and narrower proximal sesamoid bones were associated with increased fracture risk and that osteophytes were also more commonly found in the PSBs of fracture horses. Authors suggested that new high-resolution CT systems for use in standing horses may have the potential to be used as screening tools for detection of horses at risk of catastrophic proximal sesamoid bone fracture.

Palmar osteochondral disease (POD) is another common condition affecting the racehorse fetlock with lesions identified in at least 1 metacarpal/tarsal condyle in 55%-80.4% of all Thoroughbred racehorses.[10] The initial silent progression of this disease makes it the perfect candidate to benefit from early diagnostic imaging systems such as positron emission tomography (PET). A 2019 study by Spriet et al[11] validated the clinical use of PET in a TB racehorse population. The study confirmed the high frequency of the PET tracer, ^{18}F-sodium Fluoride (F-NaF) uptake in the metacarpophalangeal joint of racehorses and demonstrated the increased sensitivity of PET when compared with scintigraphy. The recognition of focal ^{18}F-NaF uptake in the proximal sesamoid bones at sites known to be involved in catastrophic breakdowns, while contemporaneous CT and MRI did not show any specific abnormalities, was another key finding. Importantly, maximum standard uptake values (SUV_{max}) were reported for the first time in an equine population. Such quantification of lesions and the establishment of a reference range for the equine fetlock will likely be necessary to aid differentiation of normal physiological bone adaptation from pathological change which will be vital to the clinical application of PET for fracture prevention in the racehorse. As testament to the rapidly evolving nature of this technology, standing PET is now in clinical use at one racetrack in North America, although no published results are currently available. A recent editorial by Denoix[12] summarised the use of PET in addition to other imaging modalities that may help predict catastrophic fetlock fractures in the TB racehorse and this topic was the subject of a recent workshop reported in EVJ.[13]

Although investigation into the predictive capabilities of advanced imaging technologies such as PET is focal in the battle against catastrophic injuries, financial and logistical constraints have the potential to withhold these modalities from many, even if they become widely available. To find a more universally available diagnostic technique, a 2020 study investigated the use of metabolomic analysis of synovial fluid (SF) in TB racehorses as an alternative diagnostic for POD.[14] Metabolite levels in the synovial fluid of 15 horses (14 TB) with a clinical diagnosis of POD (based on diagnostic analgesia and MRI) were evaluated and compared with 14 control horses (10 TB). Unfortunately, no SF metabolite concentrations were found to be statistically different between POD and the control group in this study, but patterns of change were noted and baseline metabolomic information was recorded. Importantly, the applicability of metabolomic analysis in a clinical environment was confirmed. One acknowledged flaw was the use of post-mortem sampling in 69% of control horse tests which may have altered metabolite concentrations compared with POD cases where sampling was performed ante mortem.

Bone pathologies, while important, account for only some of the MSI sustained in the lower limb during racing. Soft tissue injuries, specifically overstrain to the superficial digital flexor tendon (SDFT), are among the most common cause of wastage in the TB racehorse. Following injury less than 50% of horses will return to racing and 56% of these will reinjure.[15] Despite ultrasonography being the diagnostic modality of choice for tendon evaluation, standardised ultrasonographic predictive values have not been reported previously. In a quest to determine indices that could predict a successful return to racing, classed as completing 5 or more races, a 2018 study assessed ultrasonographic features of forelimb SDFT injuries at initial presentation in 469 TB racehorses.[16] Key factors in determining a successful return to racing were reported to be cross-sectional area (CSA) in cases with a core lesion and severity of longitudinal fibre pattern disruption in cases without a core lesion. Horses in which 50% or more of the CSA was affected or where 75% or more of the longitudinal fibre pattern was disrupted at the region of maximal injury had a reduced likelihood of making a successful return to racing.

While these B-mode ultrasonographic predictive values are of tremendous use in determining prognoses, tendon rehabilitation is notoriously difficult regardless of treatment chosen and prevention of injury or, at least, optimally guided rehabilitation is, therefore, most desirable.

A 2019 prospective longitudinal cohort pilot study investigated the ability of a novel modality, ultrasound tissue characterisation (UTC), to define forelimb SDFT ultrastructure in a population of juvenile TB racehorses.[17] Authors demonstrated the suitability of this technology for use in a field setting and determined that unlike conventional ultrasound, reproducibility of information was high both between and within users. A reference range of values for the SDFT of a juvenile training population was established and the ability of this technology to monitor changes in tendon ultrastructure over the first 6 months of training was demonstrated. Authors concluded that longer-term studies were needed to validate its clinical use and that future studies should focus on determining if UTC possesses the ability to accurately predict clinical injury or guide rehabilitation.

While MSI accounts for considerable wastage in the racehorse, current research should encourage optimism. New techniques and protocols have increased our diagnostic and prognostic abilities and research advancements inspire confidence that a future with less catastrophic injury may exist. The sobering truth, however, is that no matter how promising the research is, until new technologies can be validated for clinical use and become readily available, MSI will continue to be a significant issue for the racehorse.

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