بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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Magnetic Resonance Imaging for Digital Affections in the Horse

A thesis submitted by

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(BVSc, Cairo University, 2011; MVSc, Cairo University, 2015)

For the Degree of **Ph.D.**

(Surgery, Anesthesiology, and Radiology)

Under Supervision of

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Approval Sheet

This thesis presented by "**Yahya Moustafa Elazab Elemmawy**" to Cairo University entitled "**Magnetic Resonance Imaging for Digital Affections in the Horse**" for the degree of **Ph.D.** in Surgery, Anesthesiology and Radiology has been approved on 24/3/2020 by the examination Committee.

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Supervision Sheet

Diagnostic Imaging Modalities for Digital Affections in the Horse

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Abstract

Magnetic resonance imaging nowadays has become the gold standard for diagnosis of musculoskeletal injuries in human and equine. The present study was carried on 40 draft horses suffered from lameness restricted to the phalangeal region (fetlock, pastern and foot regions) admitted to Brook Charity, Equine Hospital, Egypt (2/2017- 2/2020). The aim of this study was to describe the magnetic resonance imaging (MRI) features of lameness cases with comparison to radiographical, ultrasonographical and gross postmortem findings. After thorough clinical examination and perineural analgesia for the digital region were performed to localize site of pain, radiographic and ultrasonographic examinations were followed. These horses were euthanized due to various causes not related to the study. Cadaver limbs were collected for MR investigation and lastly examined grossly. Seventeen lesions of the fetlock and pastern regions and 16 foot injuries were recorded and described using MRI. MRI revealed injuries of both soft and osseous tissues in 80% of examined horses, only soft tissue injuries in 16.7% of horses and only bone and cartilage injuries in 3.3% of horses. All horses had multiple MRI abnormalities. MRI revealed injuries of 10 internal hoof structures including; deep digital flexor tendon (80%), distal interphalangeal joint (60%), navicular bone (50%), collateral sesamoidean ligament (20%), distal sesamoidean impar ligament (20%), navicular bursa (10%), distal digital annular ligament (10%), sensitive laminae (10%), toric part of digital cushion (10%) and second phalanx (10%). In conclusion, MRI played a pivotal role in comprehensive evaluation of phalangeal region's injuries and it is highly recommended for examination of all structures of that region in chronically lamed draft horses.

Keywords: DDFT, hoof, MRI, navicular, sesamoidean.

Dedication

With honor, I dictate this thesis to my beloved family: my softhearted father, my affectionate mother and brother, sisters, my Life Partner (Heba), and my soulmates; Mostafa and Injy

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Prima facie, I am very grateful to Allah for achievement this work

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Contents

Lists of Tables

Tables of Review

Table of Published paper 1

Tables of published paper 2

Lists of Figures

Lists of Abbreviations:

CSL: collateral sesamoidean ligament **CDET: common digital extensor tendon**

DDFT: Deep digital flexor tendon

DICOM: Digital Imaging and Communications in Medicine

FA°: flip angle

FLASH: fast low angle shot

GE: gradient echo

HA: Hyaluronic Acid

MRI: Magnetic Resonance Imaging

NB: Navicular bone

NEX: number of excitations

PACS: picture archiving and communication system

PD: proton density

PDAL: proximal digital annular ligament

PSB: proximal sesamoid bone

PSGAG: polysulphated glycosaminoglycan

SDFT: Superficial digital flexor tendon

SE: spin echo

SL: suspensory ligament

SLB: Suspensory ligament branch

TE: time of echo

TIRM: turbo inversion recovery magnitude **STIR: short tau inversion recovery**

TR: time of repetition

TSE: turbo spin echo

Chapter (1): Introduction

Draft horses in developing countries provide essential traction power and employed in agriculture, transportation of individuals and goods, tourism and ceremonies **(Pearson and Krecek, 2006)**. Eighty three percent of working draft horses had digital flexor tendonitis in at least one limb. Distal interphalangeal (DIP) and metacarpophalangeal (MCP)/metatarsophalangeal (MTP) joints' swelling in every limb are highly prevalent **(Pritchard, Lindberg, Main and Whay, 2005)**.

The most common cause of lameness in the draft horse involves the foot. Prevalence of hoof affected animals in horses is (67.6 %) and (61.08 %) in donkeys; this may be due to poor hoof wall quality, improper or no trimming, inadequate hoof hygiene, tie stalls and confinement in wet, manure-contaminated stalls **(Fessler, 1989, Mishra, Bose, Rao and Panda, 1998, Globe, 2011)**. Navicular disease remains one of the most controversial and common cause of intermittent forelimb lameness in horses between 4 and 15 years of age represented by overlapping radiographic pictures in healthy and diseased horses. The syndrome is responsible for one-third of all chronic forelimb lameness in horses **(Macgregor, 1986, Dyson and Murray, 2007a)**.

Soft tissue injuries of pastern regions are likely underdiagnosed in draft horses, often overlooked and most practitioners are not familiar with the intricate anatomy of this area. Injury to the distal sesamoidean ligaments, collateral ligaments, and flexor tendons in the pastern can all result in lameness and even joint instability, causing ringbone months or even years later **(Grondahl, 1992, Davidson and Ross, 2003).**

Radiography is the most common imaging modality that has been widely used for the diagnosis of musculoskeletal injuries. However, it is well known that with the lack of detailed soft tissue visualization, radiography has a limited role in the evaluation of areas surrounding the bone. Skeletal abnormalities are identified radiographically based on changes in bone density/opacity (reduced or increased) and shape **(Morgan, Silverman and Zontine, 1993)**.

Because skeletal lesions may only be detected with radiographs after approximately 50% change in bone mineralization is present, some conditions such as acute osteomyelitis, early synovitis, early cartilage loss/erosive arthritis, and minimally

or non-displaced fractures may not be recognized on the initial radiographic exam. It may take up to 2 weeks before the bone changes are detected with plain radiographs **(Puchalski, 2008, Valdés-Martínez and Park, 2011).**

Diagnostic ultrasound has been increased our capabilities to evaluate the flexor tendons and suspensory ligament for morphological changes using linear array ultrasound (14 to 18 MHz) systems **(Denoix, Coudry and Jacquet, 2008)**, but the fetlock, pastern and hoof regions are more difficult to examine than the metacarpus because positioning the probe between the distal aspect of the sesamoid bones (and the ergot) and the limited access to internal hoof structures due to horny materials and the proximal aspect of the collateral cartilages **(Reef, 2019)**.

Magnetic resonance imaging (MRI) is relatively new multiplanar cross–sectional imaging modality in horses that is fast becoming the gold standard for diagnosis of musculoskeletal injury of the distal limbs in the equine patients. MRI allows soft tissue and bone structures to be evaluated in ways not previously possible. It provides superior contrast and detail, for both soft tissue and bone structures, and some physiological information on various injuries. Low - grade pathological abnormalities may be seen only using MRI in horses currently free from lameness **(Murray, Schramme, Dyson, Branch and Blunden, 2006b)**.

The increasing use of MRI in equine sports medicine requires every equine practitioner to have a basic knowledge of MRI interpretation concepts. Accurate knowledge of the pros and cons of MRI help clinicians make a careful selection of horses that undergo MRI **(Schramme and Redding, 2011)**. The use of MRI has highlighted the potential shortfalls of both radiography for imaging bone and ultrasonography for imaging soft tissue lesions. Horses with minimal radiographic abnormalities of the navicular bone were thought to respond to therapy better than those with radiographic abnormalities **(Martinelli, Baker, Clarkson, Eurell, Pijanowski *et al.*, 1996)**. However, this generalization is debatable because horses with DDFT injuries with or without navicular bone abnormalities tend to do poorly regardless of treatment **(Kleiter, Kneissl, Stanek, Mayrhofer, Baulain *et al.*, 1999)**.

Efficacy of treatment protocols tailored for each individual horse is based mainly on the results of the diagnostics available. The ability to develop a more