Studies on hoof conformation in relationship to different hoof lesions in working donkeys

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For the degree of

M.V.Sc.

(Surgery, Anesthesiology and Radiology)

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2018

Dedication

To my mother and father for all their love and prayers.

To my wife for her love, patience, and support.

To my family for the happiness they have brought to my life.

Acknowledgment

In the name of Allah, the most gracious and the most merciful Alhamdulillah all praises to Allah for the strengths, all his grants and his blessing in completing this thesis.

I would like to express my heartfelt gratitude, sincere appreciation and profound regards to Prof. Dr. Mohamed Barakat Mostafa Professor Emeritus of Surgery, Anesthesiology and Radiology Faculty of veterinary medicine, Cairo University for his unlimited help, endless advice and cheerful cooperation.

I would like to thank Dr .Ahmed Ismael Abd El Galil Lecturer of Surgery, Anesthesiology and Radiology Faculty of veterinary medicine, Cairo University for his assistance and kind advice.

I would also like to thank the members of department of Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine Cairo University for their continuous help and support.

I am especially grateful for the help and assistance received from the staff of Egyptian Society for the protection and welfare of the working animal (ESPWWA) and the Donkey Sanctuary UK.

Finally I am Indebted to My father, my Mother, my wife, my Daughters, my brothers, and my sister who have provided unstinting support as I went through the work on the master process. I am truly grateful.

Abstract

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Degree: M. V. Sc.

Specification: Surgery, Anesthesiology and Radiology.

Title of thesis: Studies on hoof conformation in relationship to different hoof lesions in working donkey.

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Abstract:

The external hoof capsule characteristics for normal 20 donkeys and 73 abnormal donkeys were described, the incidence of abnormal hoof capsule conformations and the relationship between the hoof capsule abnormalities and different lesions within the foot in the donkeys were determined. Linear and angular measurements of hoof capsule were determined for normal and abnormal donkeys using digital photography and digital image processing software AutoCAD 2014 programme. The normal front hooves were more rounded and significantly larger than hind limbs. Hoof pastern axis was naturally broken forward. The prevalence of the abnormal hoof conformations in working donkey were 78.49 %.The common abnormal hoof conformations were sheared heel 75.3 %, Flared foot 72.6%, contracted heel 31.5%,club foot 30.1% and long toe underrun heel were 24.6%. The common hoof lesions were bruised sole 60.2%,hoof cracks 42.5%, joint arthritis 41.1%,Tendonitis 34.2, Desmitis 32.8% ,hoof abscess 27.3%, white line disease 27.4%, thrush 21.9%, Granulomatous inflammation of distal limb 9%, coronary band injuries 4%. The relationship between the abnormal hoof conformation and different hoof lesions were studied. Changes in the shape of hoof capsule, predisposed to hoof imbalance and lameness. As well as morphometric measurement will provide guidelines for the development of hoof trimming and correction of foot imbalance.

Key Words: Hoof, Donkeys, hoof capsule morphology, Digital photograph, hoof lesions, linear and . ,angular measurements, trimming and Lameness

Contents

List of the abbreviations

AAEP	American association equine practitioners
DDFT	Deep digital flexor tendon
DHWA	Dorsal hoof wall angle
DIP	Distal interphalangeal
DIJ	Distal interphalangeal joint
DP	Distal phalanx
ESPWWA	Egyptian society for the protection and welfare of working animal.
HPA	Hoof pastern axis
MTC	Metacarpal bone
HW	Hoof width
MCP	Metacarpo phalangeal
MTS	Metatarsal
PIP	Proximal interphalangeal
SDFT	Superfacial digital flexor tendon
SEM	Standard error of mean
SPSS	Statistical Package for the Social Sciences

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Introduction

Donkeys working in developing countries are used for transporting both goods and people, often in extreme heat and humidity. Working donkeys are usually owned by poor members of society and seldom receive adequate resources and management to maintain good welfare.

The prevalence of lameness was 96% in previous large surveys of working donkeys Pritchard et al. (2005) and Burn et al. (2010). Working donkeys are evaluated with high prevalence of foot, joint, tendon and conformation abnormalities and chronic foot pathology Rexis et al. (2014). Hoof related lameness is common in performance and pleasure horses O'Grady and Poupard (2001) and foot conformation may be related with performance Kobluk et al. (1990).

Walker et al. (1995) reported that, there is little information regarding the anatomy of donkey feet. The absence of species specific information, there has been a tendency to apply an equine model Butler et al. (2008). However, Doguer (1943); Reilly (1997) and Collins et al. (2002) concluded that, the anatomical differences between the donkey and horse throughout the distal limb and questioned the validity of applying the horse model in donkey. The donkey hooves have a specific geometric balance that must be taken into consideration during trimming and imbalance interferences. The hooves of donkeys provide greater support; upright boxy hoof with more robust frog and a larger area of support in relation to horses and mules Souza et al. (2016).

O'Grady (2008) reported that, the equine foot has numerous functions, including supporting the weight of the horse, dissipating the energy of impact as the foot strikes the ground, protection of the structures contained within the hoof capsule, and traction. The influence of a strong functional foot on the athletic career of a performance horse and the importance of proper farriery depend on trimming and shoeing. Parks (2011) concluded that, poor conformation predisposes a horse to developing mediolateral imbalance due to poor trimming and excessive stress on the one side of the foot so that it grows more slowly than other side.

Previous studies in horses have shown that, foot conformation influences the forces experience by the distal limb Elaishare et al. (2004) and proved as a risk factor for musculoskeletal injury Kane et al. (1998); Anderson et al. (2004). Yet little information concerning donkey foot conformation and injuries have not been evaluated. Clearly more information is needed to elucidate the relationship between hoof´s conformation and lameness in donkeys. Donkey foot conformation would help to guide the veterinary surgeons and farriers in the trimming and shoeing donkey foot.

Kummer et al. (2006) and Van Heel et al. (2006) mentioned that, foot conformation can be changed through incorrect trimming, shoeing and conformational defects are the main causes of lameness in horses. Turner (1992), Sampaio et al. (2013) concluded that, the most important disorders of foot balance in horses are broken hoof axes, under run heels, contracted heels, sheared heels, mismatched hoof angles and small feet.

Boswell (2011) and O'Grady (2014) mentioned that, evaluation of the hoof capsule morphology will provide the clinician valuable data about ability of foot to excessive stress and abnormal distribution of forces that lead to hoof capsule deformation and lameness. The long toe/low heel conformation is a common problem in the horse, and may predispose to palmar lameness syndrome. Narrow, upright, under run or sheared heels will afford the horse a significant biomechanical disadvantage and may predispose to lameness.

Kobluk et al. (1990) stated that, the hoof conformation is described by linear and angular measurement of the hoof capsule, the digital bones and their relationship to each other, including direct linear measurements of the hoof capsule. Biometrics measurements are considered to be an easy process and enable objective assessment of hoof balance in horse Turner (1992). Digital photography has been demonstrated to provide a highly accurate method of measurement hoof conformation White et al. (2008) and Dyson et al. (2011).They also provide guidelines for correction any imbalance Maranho et al. (2007). A number of hoof abnormalities objectively and series of measurements to assess foot balance and to quantify morphological changes to the hoof capsule as measured against the normal hoof conformation have been considered in the horse Turner (1992), Turner and Stork (1989) and Stashak (2002).

Savoldi (2006) suggested that hoof capsule morphology can be linked to foot pathology Moreover, the prevalence of pathological hoof capsule abnormality and associated foot lesions contributing to lameness in the working donkeys.

Savoldi (2006) reported that, a lot of parameters concerning hoof shape and size depend strongly on the trimming procedure. The form of the external hoof is directly related to the form and function of the internal structures.

Little studies on morphometric measurements of hoof capsule characteristics in donkeys are available Souza et al. (2016). Morphometric measurements are considered an easy process and enable objective assessment of hoof balance and trimming Turner (1992). Moreover, Sampaio et al. (2013) and Eggleston (2012) mentioned that, the biometric hoof can help the veterinarian and farriers to correct and treatment hoof injuries in horses. Yet the effect of morphometric hoof trimming in donkeys was never considered. Trimming and shoeing affect not only the external hoof capsule but also the internal structures of the foot O'Grady (2008). Therefore, the aim of the present investigations was to:

1-Describtion the external hoof capsule characteristics and the linear and angular morphometric measurements in fore and hind limbs in apparently healthy normal donkeys and abnormal hoof conformations

2- Determination the prevalence/incidence of abnormal hoof capsule deformities in donkeys.

3-Describtion the relationships between the hoof capsule deformities and different lesions within the foot in the donkeys.

4-Describtion and evaluation of the linear and angular hoof measurements in abnormal hoof capsule and the normal healthy to be used as guidelines for hoof capsule management and trimming in donkeys.

Review of Literature

I- Hoof anatomy

Stump (1967) mentioned that, the hoof capsule displays a complex 3-dimentional Geometric form that has a distinct structural organization of hoof horn material. The hoof capsule can be divided topographically into the wall, frog, sole, and white line.

O'Grady (2008) mentioned that the hoof capsule complex in the horses can be divided into epidermal weight bearing which are hoof wall, the bars and the sole adjacent to the sole- wall junction and the frog. The other, the soft tissue structures were included palmar-planter section of the foot, digital cushion, paired ungual cartilages and deep digital flexor tendon (DDFT). The epidermal hoof wall is viscoelastic because of its biologic nature, constitutes the bulk of the hoof. The hoof wall is thickest in the toe and gradually decrease in thickness at heels. At the heels, the hoof wall inflicts at an acute angle to form the bars. The decreased thickness of the hoof wall at the heels allows for flexibility and expansion of the hoof capsule. The hoof wall and bars with the sole form the base of the hoof capsule. The heel base has weight bearing function and stability to be flexible and expand.

O.Grady (2008) mentioned that, the distal phalanx occupied two thirds of the hoof capsule and the remaining third is occupied by soft tissue structures; deep digital flexor tendon (DDFT), the frog, the digital cushion, and the ungual cartilages. These relation between these structures provides the functionality of weight bearing combined with support and anti-concussive mechanism. When any of these components, or any combination fails, excess stresses are placed on the remainder of the hoof, leading to overload.

1-1.The hoof wall:

Pollitt and Molynex (1990) reported that, the hoof wall is the part of hoof capsule that is visible in standing. The coronary band makes the proximal junction between the hoof wall and the skin, white line distal bearing border marks the hoof ground interface. The hoof wall itself can be divided topographically into three regions: the toe, quarters (both