

Incidence of Equine Hoof Derangements in Malaysian Horse Population

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Abstract: *The study was carried out to investigate the incidence of equine hoof derangements in Malaysian horse population. The horses' hooves were examined in five establishments in Selangor, Putrajaya and Kuala Lumpur. The hoof conditions and predisposing factors examined were the thrush, soft sole, seedy toe, hoof crack, hoof ring, chip hoof, displaced coronet, the management and nutritional status. These were recorded via observational and personal communication. 53 horses were selected randomly and categorized into clinically healthy, actively working and shod from different breeds and usage. Factors that were compared with the incidence of hoof derangements were breed, use of the horse, hoof pigmentation, management and nutrition. The incidence rate for chipped hoof was the highest recorded with 52 cases (53.52%). The lowest incidence rate recorded was sand crack where only a single case was recorded (0.96%). Other hoof derangements were grass crack (40 cases/I.R 41.74%), Thrush (41 cases/I.R 40.20%), hoof ring (40cases/I.R 39.00%) and horizontal crack (3 cases/I.R 3.37%). The relationship between hoof pigmentation, breed and use of horse with the incidence of hoof derangements showed no significant difference except for use of horses with the condition of thrush and chipped hoof. This implies that adequate management of the equine hoof can thwart and reduce hoof wall derangements in working and racing horses. Therefore, improved nutrition, regular trimming and shoeing can protect the menace of hoof wall derangements and improve the performance and raise magnificent breeds of horses.*

Keywords: *equine hoof derangements, incidence, horse population, Malaysia.*

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I. Introduction

One of the most magnificent structures of equine leg is the hoof. It is a hardy structure able to support travel of 30-70 km per day. Domestication of horses that started about 5000-6000 years ago does not change hooves structures and values [1]. However, problems encountered today are caused by neglecting the care for the horse's needs. The healthy horse's hooves are when there are no cracks, splits or dents in the hooves walls or soles, and without bruises and chippings [1].

There were several defined hoof derangements that afflicts horses kept in a poorly managed environments. Thrush is defined as a chronic disease of the horn of the sole of a horse's foot with sign of offensive smell [2, 3]. Thrush is characterized by an accumulation of black, malodorous, necrotic material, usually originating within the central or collateral sulci of the frog of the hoof [2-4]. *Fusobacterium necrophorum* bacteria that cause thrush are normally found in horse's environment especially in wet, unsanitary conditions such as dirty stable or muddy paddock and it require low oxygen environment to grow and cause infection [5]. Horses standing in urine and manure soiled bedding, neglected daily foot care and lack of exercise are the contributing factors for thrush. Inadequate or improper trimming and shoeing, which promotes long contracted heels and deep sulci appears to increase the risk of infection [6].

Seedy toe or white line disease is the term used for the separation between the hoof wall and sole at the white line. It can involve any part of the wall from the toe to the heel and can spread either vertically up the hoof wall or horizontally toward the toe or heel [5]. The space is usually filled with a white chalky substance or thrush foul smelling, tarlike residue [6]. Initial separation of the wall may not cause lameness as it is on insensitive tissue. However, lameness can occur when dirt and other material are stuck in the crevices resulting in hoof wall infection or abscesses. Ground forces cause separated wall to splay out and tear the sensitive tissue.

So, early identification can prevent the severity that would lead to lameness. Factors that contribute to the disease include irregular shoeing or trimming, poor hoof wall conformation, imbalance hoof moisture, or direct trauma to hoof wall [5].

Soft sole is defined as soft, crumbly horn in the sole of the hoof [7, 8]. Bruised sole and corns are the common conditions that occur as a result of soft sole. Rupture of blood vessel in the dermis beneath the sole, frog or hoof wall due to thin sole that easily get injured lead to bruise formation. Bruising may later develop into an abscess which can cause various degree of lameness if left untreated. Corn is a bruise that involves the tissues of the sole at the angle formed by the wall and the bar and often referred as the “seat” of the corn [6]. Very wet condition and over-trimming of the sole may lead to soft sole [5].

Hoof crack is the separations or breaks in hoof wall. There are different types of cracks depending on the location and originating line of the crack. Vertical cracks are divided into sand and grass crack. Sand or incomplete crack originate at the coronet while grass crack starts from ground surface. There are different locations of cracks namely toeing cracks, quarter cracks and heel cracks. Horizontal crack in the hoof wall is called “blow out”, caused by either an injury to the coronary band or by blow to the hoof wall [6]. Hoof cracks occur from improper foot balance, coronary band defects, excessive growth of hoof and thin, dry or wet hoof walls [4].

Hoof wall ring formation can be unilateral resulting from trauma or bilateral resulting from selenium toxicosis, laminitis or generalized systemic disease. Hoof ring formation is not always associated with lameness unless severe [6]. Amino acid D-L methionine, vitamins, biotin and sulphur are vital for the hoof which acts as chemical bridges that hold the horn tubules together [6]. By using one or combinations of these supplements will improve the horn quality within 6 months. Hoof oil may have little effect to improve the appearance of hoof compared to supplement because it does not penetrate significantly into the hoof wall [9].

Chipped Hoof occurs when long hooves are left without proper trimming or shoeing for a protracted period. Mediolateral and dorsopalmar hoof imbalance also lead to chipping of hooves where the elongated hoof wall from other side can easily chipped and crack with the effect of concussion on the ground [4, 10]. However, this condition can be repaired with proper management of trimming and shoeing period. Maintenance of the environment from too wet or dry is also imperative [10, 11]. Horse hooves may be compromised when the moisture contents does not remain reasonably constant where it weakens and damage essential molecular links which hold keratin of the horn [6, 10].

Displaced coronet is the condition that occurs if a small area of the hoof is allowed to be too long or growing fast. Focal pressure directed up to the hoof wall will cause a section of the coronet to be displaced upward and it may result in a crack in the hoof wall and bulging formation at the coronet area. This condition often goes undetected and may be the cause of subtle lameness [6, 10]. However, swelling at the coronet can result from scar formation from injury such as wire cuts or bruising during exercise, dermatitis, or deeper involvement such as quittor [6, 10]. Normal percussion of the hoof produces a crispy resonance, while hoof wall detached from its deeper structures has a dull resonance [10]. Radiography is practical in identifying gas under the hoof wall, which signifies either infection or damaged hoof wall [12].

Since the mid-1980s, Malaysia has witnessed a dramatic increase in the number of horses, equestrian clubs, riding schools, endurance stables and private or semi-private ranches [13]. Equine sports in Malaysia have become one of the most popular sports. Malaysia hosts various equine sporting events ranging from national, regional and international levels. Equine industries may not be able to reach its height in national and international levels if the conditions of horses are not well managed. Hoof derangement is one of the commonest disorders confronting horses and is a major cause of lameness if it is deep seated. It is one of the conditions that cause deformity, loss of aesthetic values and athletic performances. Hoof derangements are affected by many factors including breed, type of work, injury and management. Poor management is the most common contributory factor of hoof derangements. Therefore, this study is conducted to examine the incidence of hoof derangements in Selangor, Federal Territory of Kuala Lumpur and Putrajaya. The study will assist veterinarians and horse owners to develop measures for the proper management of horses with both clinical and subclinical hoof derangements.

II. Materials and Methods

Selection of Establishments and horses

Five equine establishments in Selangor, Putrajaya and Kuala Lumpur were selected randomly for the study. Horses at each establishment were selected via stratified sampling and they were categorized into healthy, actively working horses and shod. A total of 53 from 98 horses were selected from 5 establishments of different usage and breeds and the study was carried out over a period of 6 weeks duration.

The criteria for assessing an establishment as good or poor depends on the degree to which the establishments managed the horses, stables, the conditions of the horse's hooves and the nutritional aspects of the horses. The establishment that has lower incidence rates of hoof derangements, an excellent stabling care, with good feed provision and adequate feed supplements is graded as good while, the establishment that did not uphold to these criteria was graded as poor.

Data Collection

The hooves of all the four legs of the horses were examined via observation and with the aid of hoof knife, hoof picks and hoof tester. Hoof cracks, hoof rings, chipped hoof and displaced coronet were identified when the horses were in standing squared position. The hoof was lifted and the sole were assessed for thrush, soft sole and seedy toe. Pigmented and non pigmented hooves were recorded as additional data for correlation between pigmented hoof and hoof abnormalities. Management and nutritional status of each establishment were recorded through observation and personal communication.

Data analysis and evaluations

Incidence rate for each hoof derangements were counted and relative risk is used to relate with the management and nutritional levels using the formula:

Incidence rate (I.R):

$$I.R \% \text{ hoof derangement} = \frac{\text{Total no of new cases}}{\text{Total number of horses in each establishment}}$$

I.R % in 5 establishment = mean value of incidence rate for 5 establishments.

Relative risk (RR) formula:

$$RR = \frac{\text{Incidence rate of poor establishment}}{\text{Incidence rate of best establishment}}$$

Each condition was scored for severity evaluation. For thrush, the scoring was:

1 = very mild; affected only a part of sole or frog and minimum powdery or presence of smell.

2 = mild; affect both sole and frog area, powdery and presence of smell.

3 = moderate; powdery at both sole and frog with bad smell.

4 = moderately severe; very powdery and complete powdery, smelly frog. The sole may become soft with swollen frog.

5 = severe; thick powdery sole and frog area with presence of bad smell. The sole is soft, swollen frog and with presence of blackish necrotic tissue especially at the groove area and sulci.

For hoof rings, the presences of rings were counted to relate with nutritional factor or traumatic origin.

Seedy toe, soft sole, hoof cracks, chipped hoof were scored into;

1 = mild; involved not more than 1/3 of the hoof area.

2 = moderate; involved above 1/3 of the hoof and with more than one area.

3 = severe; deeply seated and may involve the sensitive laminae.

Each condition was scored for severity evaluation and was analyzed with the statistical software package JMP 9 (SAS, QSAS Institute Inc, Cary, NC, USA). Chi square test were used and kruskal Wallis for non parametric data. Analyses were considered as significant at $p < .05$.

III. Results

Six types of hoof derangements were recorded in 53 horses in 5 establishments in Selangor, Putrajaya and Kuala Lumpur (Table 1). The abnormalities were chipped hoof, thrush, hoof ring, grass crack, horizontal crack and sand crack. The incidence of chipped hoof in the 5 establishments was the highest recorded with (52 cases/I.R 53.52%). The lowest incidence rate recorded was sand crack with only (1 case/I.R 0.96%) recorded. Other hoof derangements were grass crack (40 cases/I.R 41.74%), thrush (41 cases/I.R 40.20%), hoof ring (40 cases /I.R 39.00%) and horizontal crack (3 cases/I.R 3.37%).

Thrush were recorded in all 5 establishments and was highest in establishment E with the incidence rate of 50%, followed by establishment D (47.6%), establishment B (45.5%), establishment A (34.8%) and the lowest incidence rate was in establishment C (23.1%). Incidence rate of chipped hoof was the highest recorded in establishment B (72.7%), followed by establishment D (61.9%), establishment A (52.2%), establishment E (50%), and lowest in establishment C (30.8%). The incidence rate of grass crack was highest in establishment B (63.6%), and lowest in establishment C (15.4%), while establishment A had (43.5%), E (43.3%) and D (42.9%). Hoof ring recorded the highest incidence rate of (63.6%) in establishment B, establishment E had (50%), establishment A had (48%), establishment D had (33.3%) and none was recorded in establishment C. Horizontal crack had the highest incidence rate in establishment C (7.7%), establishment D had (4.8%), establishment A had (4.35%), and it was absent in establishment B and E. Sand crack was only recorded in establishment D with the incidence rate of 4.8%.

Relative risk of hoof derangements among establishment with different management level

The incidence rate of thrush in well managed establishment (C) was 23.1% while poorly managed establishment (E) had the incidence rate of 50%. The risk of thrush among horses in the poorly managed establishment compared to the well managed was 2.2 or twice and 1/8 more likely to develop the incidence of thrush. Incidence rate for chipped hoof was higher in establishment B (72.7%) compared to establishment C (30.8%). The risk of chipped hoof among horses in establishment B compared to establishment C is 2.4 times more likely to develop chipped hoof. Grass crack is another hoof derangement with high incidence rate and related to management factors. Establishment C had lowest incidence rate (15.4%) while the highest was in establishment B with the incidence rate of 63.6%. The risk of grass crack among horses in establishment B was 4.1 times more likely to develop grass crack. However, relative risk for horizontal crack and sand crack were too low to be calculated since the cases were too low with 1 case or none in each establishment.

Relative risk (RR) of hoof ring among establishment with different nutritional levels

High incidence of hoof ring occurred in establishment B (63.6%) and low incidence was observed in establishment D (33.3%) respectively. The risk of hoof ring among horses in establishment B was 2 times more likely to develop compared to establishment D.

Correlation between breed, usage, pigmented and non pigmented hoof with hoof derangements

There was no significant difference between pigmented and non-pigmented hoof with hoof derangements (chipped hoof, hoof ring, and hoof crack) ($p < 0.05$). This result indicates that pigmentation of hoof does not relate to the incidence of hoof derangements (table 4). The relationship between usage of horses and hoof derangements showed significant difference for thrush ($p < 0.001$) and chipped hoof ($p < 0.005$). However, there were no significant differences in hoof ring and hoof crack.

Table 1: Incidence of hoof derangements in five establishments

Type of Hoof Derangements	Total no of cases	Incidence (I.R) %
Chipped hoof	52	53.52
Thrush	41	40.20
Grass crack	40	41.74
Hoof ring	40	39.00
Horizontal crack	3	3.37
Sand crack	1	0.96

Total number of horses, 98

Table 2: chi square test results for usage of horses (patrol, endurance, riding, dressage, jumping, and polo) for hoof derangements.

Type of hoof derangement	χ^2	P value	Sig.*
Thrush	20.539	0.001	*
Hoof crack	7.321	0.198	NS
Hoof ring	3.100	0.685	NS
Chipped hoof	16.967	0.005	*

* Sig; NS = Not significant; significant when p value $< .05$

Table 3: chi square test result for breed of horses (Thoroughbred, Arab and others) with hoof derangements

Type of hoof derangement	χ^2	P value	Sig.*
Thrush	1.426	0.490	NS
Hoof crack	2.014	0.365	NS
Hoof ring	1.573	0.456	NS
Chipped hoof	2.929	0.231	NS

* Sig; NS = Not significant; significant when p value $< .05$

Table 4: chi square test results for pigmented versus non-pigmented for hoof derangements

Type of hoof derangement	χ^2	P value	Sig.*
Hoof crack			
FL-Right	0.009	0.925	NS
FL-Left	1.267	0.260	NS
HL-Right	0.164	0.686	NS
HL-Left	0.002	0.968	NS
Hoof ring			
FL-Right	0.251	0.616	NS
FL-Left	0.958	0.328	NS
HL-Right	0.352	0.553	NS
HL-Left	1.207	0.272	NS
Chipped hoof			
FL-Right	1.142	0.285	NS
FL-Left	0.778	0.378	NS
HL-Right	1.362	0.243	NS
HL-Left	0.480	0.488	NS

*Sig; significant when p value $< .05$



Plate 1: Chipped Hoof (Severe)



Plate 2: Thrush (Moderate)



Plate 3: Grass crack (Mild)



Plate 4: Hoof ring



Plate 5: Horizontal crack (mild)



Plate 6: Sand crack (mild)



Plate 7: Dry and clean sawdust bedding



Plate 8: Sawdust contaminated with faeces

IV. Discussion

In the present study, the results of incidence of hoof derangements in 5 establishments showed that chipped hoof had the highest recorded new cases. Grass crack was the second highest recorded incidence rate. It can be deduced that incidence of chipped hoof and grass crack in actively working and shod horses is high. This condition may occur due to increase concussion to the ground during riding. The finding from the current study was similar to the study conducted by [7, 8] where the occurrences of both chronic laminitis and compression of the hoof wall was assumed to be due to the episodes of chronic laminitis and to severe

trauma during work and compression of the hoof wall tubules during heavy work loads. In the present study, incidence rate of thrush was also similar to grass crack. The daily neglect of daily foot care and improper trimming is the most probable cause of the incidence. Most of the horses that have thrush had wet sole and sports reduce hoof wall strength and lead to chipping and crack. It is also caused by improper trimming of the hooves leading to hooves imbalance (mediolateral or dorsopalmar imbalance) allowing chipped and grass crack to develop. According to [7, 8] Hoof wall cracks are usually illustrated by their location, length, depth and presence or absence of hemorrhage or infection. In a study carried by [8], the prevalence of superficial partially quarter cracks and toe cracks were higher, and [14] deduced that from toe, the hoof wall becomes increasingly thinner to the quarter and it is more sensitive to cracks; consequently, thinner quarter walls could have a higher incidence of cracks than that at the toe. Besides, heel and quarter cracks are recurrently linked with under-run heels and long toes and this hypothesis supports our observation of cracks in the current study. [14] reported that incessant hoof wall growth makes it susceptible to splitting and cracks. In the present study, horizontal crack was the second with least incidence rate. This type of crack could occur by an injury to the coronary band or blow to the hoof wall. The crack may go unnoticed until the farrier spot it and seldom increase in size and usually require no treatment. However, if the hoof is left undermined by excess moisture and mediolateral imbalance horizontal crack can set the stage for a vertical crack to occur. This finding from the current study is in accord with the studies conducted by [4, 10]. In the present study, the lowest incidence rate was sand crack. Sand crack may result from injury to the coronet or from an infection that breaks out the coronet vertically. It may also cause by uncoordinated movement of horse where it might strike the coronet and also it can develop with mediolateral and diagonal imbalance. This finding is in agreement with the study conducted by [6]. In the current study, from the observation and by personal interview with the keepers, these horses frequently urinate in large amount, and left in the stable for a prolonged period creating a wet saw dust leading to the development of thrush in an environment that was suitable and enriched for bacterial growth. Frequent removal of the saw dust will reduce the problems and improve the hygiene of the good environment.

The incidence of hoof ring was the second highest derangement among the 5 establishments may not always be associated with lameness. This condition is purely physiological and it occurs when the amount of blood supplied to the coronary region is reduced. This finding was similar to the study conducted by [8] while, [15] considers that hoof rings indicate occurrences of chronic laminitis but [8] regarded these rings as emanating from the frequent compression of the outer portion of the hoof wall with ensuing buckling of the superficial horn tubules. However, it is often related to nutritional factors associated with supplement such as biotin that is imperative for hoof growth and strength [6, 16]. When it was kept balance and natural the hoof condition will improve and the horse remains healthy [16]. [16] indicated in their study that injuries at the coronary band also lead to the reduction of the normal hoof growth. Condition of soft sole, seedy toe and displaced coronet were not present in this study. These conditions commonly present when the horses showed sign of lameness and not present in actively working horses.

In the present study, the incidence rate of hoof derangements was higher in establishment E compared to the other four establishments. Establishment E is the only establishment that did not employ a farrier and the farrier only comes after an interlude of four weeks or when their services are needed. Regular check of hooves has been neglected and lead to the high incidence of hoof derangements in this establishment. Establishment C showed the lowest incidence of each hoof condition and therefore, this establishment was assumed to have a good management practice. The establishment has a farrier, and regular checking of hoof condition is paramount and a scheduled periodic shoeing was able to maintain the hooves in good condition. Farriers play an important role in the hoof care because some of the horse workers still lack the knowledge on proper hoof care. This finding is similar to the study conducted on the field by [8] on hoof wall problems in unshod working horses. The relative risk for most hoof derangements that are related to management factors, are many times more likely to develop regarding each condition that was improperly managed in the various establishments, an exception was the grass crack which had a higher relative risk. Poor management such as unchanged wet saw dust, improper trimming and neglected daily hoof care could weaken the inner structure of the hoof wall. Increase concussion on the ground in actively working horses caused hooves to easily crack and the occurrence of grass crack is the most common compared to other hoof derangements.

Poor nutritional level contributes to the formation of hoof ring. The relative risk of hoof ring is two times more likely to develop in establishment with poor nutritional level. Establishment D had the lowest

incidence rate of hoof ring while establishment B had highest incidence rate of hoof ring. Biotin, calcium and selenium are the most important components in the daily requirement for hoof maintenance. All of these components can be gotten from green pasture. However, most of the establishments in the present study were not able to provide green pasture due to limited grazing area and they depend on commercial feed. Some commercial feed however, lack biotin, calcium and selenium as an adjuvant in the feed and therefore, needs to be added separately. By given biotin alone as supplement is enough to increase hoof strength and for hoof growth. From personal communication, Establishment B is identified as establishment that did not provided biotin as supplement. This finding is in accord to the study conducted by [16]

Correlation between breed, usage and hoof pigmentation with hoof derangements only showed significant difference for usage of horse with thrush and chipped hoof condition. Different usage of horses such as patrol and endurance had different frequencies of concussion to the ground leading to chipped hoof when the shoe nail migrated and the shoes not firmly attached. Prolonged contact of the hooves to the ground such as soil could also lead to thrush and *Fusobacterium necrophorum* infection in the soil. This findings is in agreement to study carried out by [5].

V. Conclusion

In conclusion, improved nutrition, regular trimming and shoeing can protect the menace of hoof wall derangements and improve the performance and raise magnificent breeds of horses.

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