



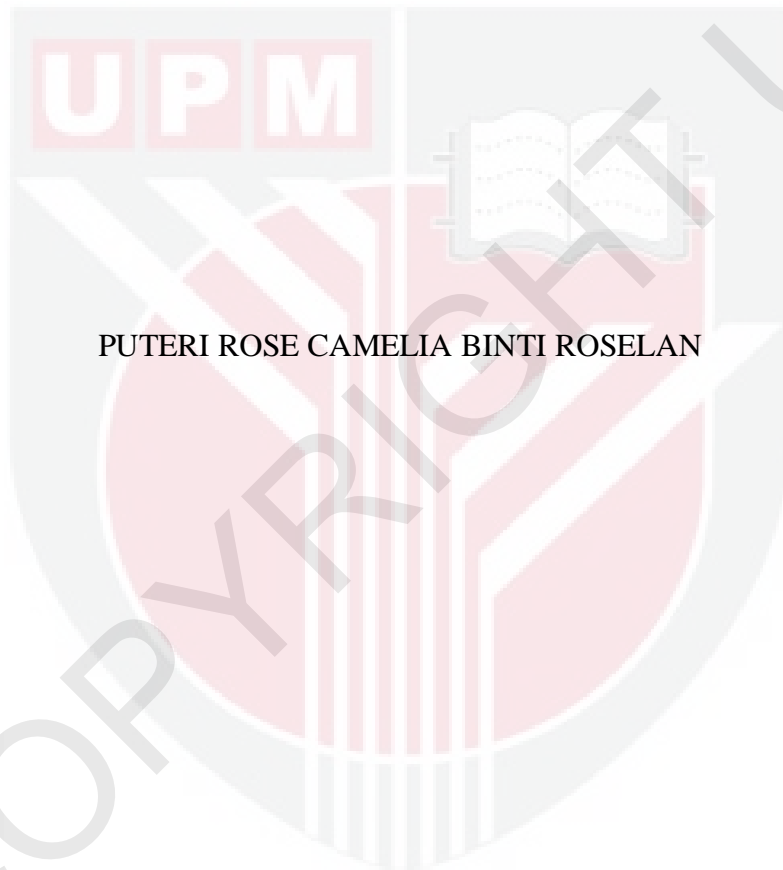
UNIVERSITI PUTRA MALAYSIA

**RETROSPECTIVE STUDY OF RADIOGRAPHY FINDINGS OF FETLOCK
AND HOOF DISEASES PRESENTED AT SELANGOR TURF CLUB (STC),
FROM JANUARY 2019 TO AUGUST 2022**

PUTERI ROSE CAMELIA BINTI ROSELAN

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DISEASES PRESENTED AT SELANGOR TURF CLUB (STC), FROM JANUARY 2019
TO AUGUST 2022



PUTERI ROSE CAMELIA BINTI ROSELAN

A project paper submitted to the
Faculty of Veterinary Medicine, Universiti Putra Malaysia
In partial fulfilment of the requirement for the
DEGREE OF DOCTOR OF VETERINARY MEDICINE

Universiti Putra Malaysia
Serdang, Selangor Darul Ehsan
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CERTIFICATION

It is hereby certified that we have read this project paper entitled “Retrospective Study Of Radiography Findings Of Fetlock And Hoof Diseases Presented At Selangor Turf Club (STC) From January 2019-August” by Puteri Rose Camelia Binti Roselan and in our opinion, it is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999 - Final Year Project.

MOHD HEZMEE MOHD NOOR

DVM(UPM), PhD (Queensland)

Associate Professor

Department of Veterinary Preclinical Sciences

Faculty of Veterinary Medicine

Universiti Putra Malaysia

PROF DR. HAFANDI AHMAD

BSc. Hons. (UPM), MSc (UPM), PhD (La Trobe)

Associate Professor

Department of Veterinary Preclinical Sciences

Faculty of Veterinary Medicine

Universiti Putra Malaysia

DR. SHRI KANTH KANAESALINGAM

DVM(UPM), CERT. OF EQUINE MEDICINE AND SURGERY (SYDNEY), KMN

Chief Veterinary Surgeon/ Senior Manager

Selangor Turf Club

(Co-Supervisor)

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In the name of God, the Most Gracious, the Most Merciful

All praises to The One. Thank you for everything, for the ones I prayed for and for the ones You gave me without me asking, as You are my Creator, knowing what is the best for me. My parents, Roselan Bin Mohd Zain and Khalijah Binti Omar, are the ones who believed in me since I was a child until now. No deeds can repay your love and thoughts for me throughout these years. For my cats, Tomey, Toyeng, Tata, TJ, and Tora, my cat therapist. Thank you for letting me hug you all the time. To Dr Shri and Selangor Turf Club staff, thank you so much for your knowledge, patients and hospitality throughout those 5 weeks. I've learned a lot and a memorable memory when I looked back on my DVM years. To my supervisors, Dr Hezmee and Dr Hafandi, thank you for your guidance and understanding throughout my final year project and for giving me chance to work with you. To my Rumah Syurga, thank you. No words can explain my gratitude to you, may Allah bless your good deeds with more rizq. To Zi Yan, thank you for being my fypmate, all your advice throughout these 5 weeks shall not be forgotten. To Jin Yu, thank you for accompanying me throughout those days. To my DVM23 friends who help me directly or indirectly, I truly appreciate your time. Lastly, to myself, thank you for not giving up. Let's just enjoy this last year of DVM and start loving ourselves more, shall we?

With God Wills.

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ABSTRACT

An abstract of the project paper presented to the Faculty of Veterinary Medicine in partial fulfilment of the course VPD 4999 – Final Year Project

TITLE: RETROSPECTIVE STUDY OF RADIOGRAPHIC FETLOCK AND HOOF DISEASES PRESENTED AT SELANGOR TURF CLUB (STC), FROM JANUARY 2019 TO AUGUST 2022

By:

PUTERI ROSE CAMELIA BINTI ROSELAN

2022

Supervisor: Associate Professor Dr Mohd Hezmee Bin Mohd Noor

Co-supervisor: Associate Professor Dr Hafandi Ahmad, Dr Shri Kanth Kanaesalingam

No leg, no horse is common phrase to emphasize the importance of the equine limbs, especially to a racing horse. Any injury could cause lameness and leads to unsound horses, thus eventually become economic losses. Fetlock and hoof are one of the vulnerable parts to cause lameness, and in chronic cases radiographic imaging is needed to have a better diagnosis. However, there is not much of study in terms of the total occurrence of radiographic fetlock and hoof disease until this present. This present study was performed to determine the frequencies of the radiographic fetlock and hoof disease in Thoroughbred racehorses from January 2019 to August 2022 presented at Selangor Turf Club (STC). Radiographic records for horses presented at STC Equine Hospital were assessed for the occurrence radiographic of fetlock and hoof diseases. A total of 226 sample of horses were included in the study, with 178 fetlock cases and 43 hoof cases. In fetlock cases, among 344 abnormalities collected; fracture of the fetlock has the highest percentage (19%) whereas first phalanx chip fracture is the most fractured location (41%), degenerative joint disease (18%) and desmopathy of the suspensory ligament (16%), where the insertion of the medial side being the most affected (54%). In hoof cases,

among 45 abnormalities present; laminitis (22%) is the most common findings, subsequently by proximal interphalangeal joint disease (13%) and fracture of hoof (11%) where middle phalanx has the highest fracture number with 60% occurrence. The information gained by this study concludes that there are diverse radiographic fetlock and hoof diseases, hence helps in more understanding of the diseases for future references.

Keywords: equine, fetlock, hoof, radiographic, diseases

ABSTRAK

Tiada kaki, tiada kuda. Pepatah yang sering didengar dan menekankan kepentingan kaki kuda terutamanya kepada kuda lumba. Sebarang cedera akan menyebabkan kuda tempang dan seterusnya tidak sesuai lagi ditunggangi, lantas menjejaskan ekonomi. dan telapak kuda ialah anggota yang berisiko tinggi untuk menjadi tempang, dan dalam kes-kes kronik, dan gambaran radiografi diperlukan untuk mendapatkan diagnosis yang lebih baik. Kajian ini dilaksanakan bagi menentukan kekerapan penyakit radiografi keting kuda dan telapak dalam kuda lumba Torugbred daripada tahun Januari 2019 sehingga Ogos 2022 yang dibentangkan di Selangor Turf Club (STC). Rekod radiografi kuda yang dibentangkan di Hospital Eku Kelab Lumba Kuda Selangor diakses untuk memperolehi kejadian penyakit radiografi keting kuda dan telapak kuda. Sejumlah 235 kes telah dinilai dalam kajian ini, di mana 177 kes keting kuda dan 43 kes telapak. Bagi kes keting kuda, dari 344 kes penyakit yang dikumpul, keretakan keting kuda mendapat peratusan tertinggi (19%), di mana kebanyakan belaku di kawasan keretakan cip PI (41%), diikuti oleh penyakit degeneratif sendi (18%) dan penyakit ligamen penggantung (16%). Bagi kes telapak, dari 45 kes, laminitis (22%) merupakan nilai tertinggi disertai oleh penyakit sendi interphalangeal proksimal (13%) dan keretakan telapak (11%), di mana falanks tengah (11%) memperoleh jumlah lokasi keretakan tertinggi.

Kata kunci: kuda, keting kuda, telapak, radiografi, penyakit

1.0 INTRODUCTION

Horses are always known to be extraordinary athlete and to compete in a race, the physical well-being of a horse is important to have our attention on such as changes in body score, hoof, behaviour, appetite, dropping or any particular signs of pain (Warren, 2002). Any changes in their physical well-being might lead to lameness, and severe chronic lameness may progress to serious injury and serious death. These condition does not only cause economic loses, they can also lead to catastrophic events during the race, hence it is important to identify the cause of disease to preserve the integrity and safety of the sport and meet the benchmark of the welfare of the animal. (Grundmann et al., 2014)

Lameness is a symptom that is characterised by a deviation from the regular walking pattern brought on by a structural or functional dysfunction of the locomotor system. Equine lameness is compensated for by certain body parts moving differently (Dyson, 1989). More than 50% of race horses experienced some lameness during their athletic careers, and in 20% of those instances, the lameness was severe enough to keep the animals from competing following the injury. Additionally, it's believed that subclinical abnormalities of the locomotor system affect 75% of horses with poor performance. (Stover, 2003)

There are many factors contributing to lameness. Morky and others (2021) mentioned in their recent paper that more than 90% of forelimb lameness is due to problems at the distal carpus, associated with foot conformation. Besides that, musculoskeletal problems are also a common problem that usually arises every time a racing Thoroughbred horse is mentioned to have lameness. Musculoskeletal injuries are also known to be the main cause of racehorses losing their training days due to resting periods (Cogger et al., 2006). Dik et al., (2015) supported this statement by stating that 75% of horse injury is due to musculoskeletal diasese, followed by cardiovascular disease (20%) and respiratory disease (5%). Based on an article by

Stover (2003) that did a study on the epidemiology of racing Thoroughbred injuries, most racehorses in training choose not to participate due to musculoskeletal injuries. In an English survey, 45% of horses reported musculoskeletal issues as the reason they did not start a race throughout the year

The ability to compete effectively may be impacted by conformation, management aspects such as training techniques, amount of schooling and performance, duration between starts, type of ground surface in training and competition, quality of horseshoeing, and saddle fitting. Therefore, horse sports medicine and animal welfare place high importance on the prevention and early detection of locomotor illnesses (Burn, 2006).

To diagnose a lame horse, methods have been proven to help to do so, such as trotting the horse and hoof tester. Even so, those methods are not aiding enough in terms of localizing the source of pain. "Accurate lameness diagnosis is dependent on a good clinical examination, localization of the sources of pain causing lameness, high-quality diagnostic imaging, knowledge of both image interpretation and the limitations of each imaging modality and recognizing the need to correlate all pieces of information." (Dyson & Murray, 2007). Furthermore, chronic lameness is more preferred to be diagnosed with diagnostic imaging, for example, radiographic images, due to the involvement of the tendons, ligaments, bones and soft tissues. As studied by Vanderperren and Saunders, bony lesions are identified by using radiography and assist in visualizing lesions that are not reachable to ultrasound.

There is still limited study on horse racing industry in Malaysia and not much of literature available on radiographic fetlock and hoof diseases in Malaysia. Hence the objective of this study would be to determine the overall occurrence and types of radiographic hoof and fetlock disease that are commonly presented at Selangor Turf Club (STC).

2.0 LITERATURE REVIEW

2.1 Anatomy and the Biomechanics of the Fetlock.

The fetlock joint is also commonly known as the metacarpo-phalangeal joint. To make a fetlock joint, it needs a third metacarpal bone (MCIII), two proximal sesamoid bones and the proximal phalanx bone (PI). As explained by Butcher and Ashley-Ross (2002), the fetlock joint is different compared to other joints as its movement is constricted to the sagittal plane. During racing, jumping or any athletic events, the fetlock joint carries a high motion of force as it can have an extension and flexion to 120°. This made the fetlock joint as unique as it is, for having a high degree of activity and presenting the most range of any equine joint. (Berton, 2014). This statement also has been support by Dick et al., (2015), as the fetlock is the singular joint to withstand the weight with only one digit composed of the proximal, middle and distal phalanx.

These elastic tendons such as the superficial and deep digital flexor tendon are organized at the flexor facet of the equine leg, traveling all of the way from the the distal end of the humerus/femur to the digit, crossing numerous joints, covered with the aid of using tendon sheaths (type II tendons) and supported by their respective accessory ligaments, typically referred to as the superior and inferior check ligament, and the ligamentous third interosseous muscle, normally called the suspensory ligament. (Dik et al., 2015)

Based on the article by Dik et. al (2015), the biomechanics of the fetlock starts off when the straight horse leg changes switch dramatically withinside the fetlock joint, which is hyperextended in the standing horse. During locomotion, this joint turns into even extra prolonged and causes the flexor tendons to stretch whilst the leg is on the ground. When the leg leaves the ground, the tendons loosen up and launch their energy. The proximal sesamoid bone and the distal interphalangeal joint increase the space among the joints and the flexor

structures, consequently, increasing their lever arm. Although those physiological adaptations are successful in reducing the risk of locomotion, they come at a cost. Light distal limbs and elastic tendons have small cross-sectional regions, for this reason, present processes with excessive stresses and therefore are vulnerable to injuries.

The horse's musculoskeletal system has several energy-conserving mechanisms based on the elastic properties of tendons, which allow them to store elastic energy when stretched and released on recoil (Dick et. Al, 2015). For creating such powerful movements, elastic suspensory apparatus aids in forming a fetlock joint such as the suspensory ligament, proximal sesamoid bone and distal sesamoid ligament. The suspensory apparatus works in terms of accumulating and returning the elastic strain energy during movement. By implementing this method, the forces from the ground can be reduced during limb loading as the suspensory apparatus will be lengthened, mimicking an elastic spring, and restoring the energy by recoil. (Butcher & Ashley-Ross, 2002). This is supported by Sacchi (2008), where it is stated that the forces can be reduced by up to 50% due to the support of the elastic strain stored in the tendons and ligaments.

Other than that, the elastic system of the fetlock joint also works as a long lever arm, as mentioned by Sacchi (2008). It is further explained that the mechanism of this starts during the fetlock extension, where it will extend the palmar/plantar tissue. The return energy stored in the palmar/plantar soft tissue helps in limb flexion and forward motion. When the load pressure on the fetlock increases, the joint will extend more, and transfer the load pressure to the first phalanx and the suspensory apparatus. During a high-intensity movement such as maximal weight-bearing at a racing speed or jumping, the fetlock will overextend, causing a right-angle approach of the long bone. During a normal condition or a fully resting horse, compression and shear are produced due to the compression from two regions, one of which would be between the PI and the dorsal articular surface of the MCIII. The other region is the palmar/plantar

apical region of the MCIII, having contact with the proximal sesamoids and intersesamoidean ligaments.

2.2 Anatomy and the Biomechanics of the Hoof

The foot of an equine is a multiplex anatomical structure. In general, the hoof of a horse consists of the integument structure of the horse's foot, as in the epidermis, dermis and subcutaneous tissue. There are two parts of the hoof, which are the keratinised portion and the horny wall. The keratinised portion includes the stratum corneum of the limbus, corona, wall, sole, frog and heel bulbs. The horny wall comprises the stratum Internum, stratum medium and stratum extremum. (Sherlock & Parks, 2013). The support of the musculoskeletal system in horses would be the lamellar attachments of the epithelium, where the underlying dermis holds the distal phalanx from the hoof capsule. Horan et. Al (2021) also stated that the skeletal part of the hoof consists of the distal sesamoid bone or also called the navicular bone, which is located caudal to the distal interphalangeal joint.

To go in depth, the lamellar is made up of the interdigitating lamellae epidermales and lamellae dermales, which made up the stratum lamellatum. The stratum reticulare, is placed in between the stratum lamellatum and the distal phalanx, which helps in the adhere of the distal phalanx to the lamellae epidermales. This attachment also assists in the blood vessel supply. Another important anatomical feature of the hoof is the junction of the wall and the sole, which is the terminal horn tubules. These structures can be found at the junction of the wall and the sole, also known as the distal extent of the dermis parietin, where the lamellae continue into the papillae dermales, with papillae overlying. (Grundmann et al., 2014)

With every movement of the horses during an athletic event, the structures of limbs will be under high stress, a consequence of the contact of the hoof and the ground. The hoof structures act as shock absorbers, where the shock waves produce disperse by the visco-elastic mechanism. "Most of the dampening in the equine foot probably takes place in the hoof wall,

the laminar attachments and the suspensory system.” (Dyhren Poulsen et al., 1994). Another method of reducing the load impact is by landing asymmetrically with the lateral side of the hoof, hence during the impact, it will allow gradual loading. (Burn, 2016)

The abaxial expansion of the heels at the both coronary and distal borders, together with the caudoventral rotation of the dorsal region of the hoof wall is identified as the hoof mechanism (Colles, 1989 as cited in Horan et. Al, 2021). As reported by Burn (2006), the collision impact produced is correlated with Newton’s Second Law of motion, where force is equal to the multiplication of mass and acceleration. Hence, any contact of the hoof or mechanical responses of the hoof is known as hoof acceleration. Even so, the interaction of the hoof and the ground are still likely to be uncertain (Burn, 2006). As said by Horan et.al (2021), two hypotheses arise from this question known as the pressure theory and the depression theory. The pressure theory states that “frog pressure causes compression of the digital cushion, with resultant outward movement of the hoof cartilages and hoof walls.”, while the depression theory claims that the expansion of the heels to the depression of the digital cushion by the middle phalanx as in descended under load. (Colles, 1989 as cited in Horan et. Al, 2021)

Many studies have been done in terms of the mechanical how forces produced during contact are reduced and which structure is the most affected. Burn (2006) further explains that the hoof and ground interaction is categorised into three principal phases. The first one would be impact followed by support and break-over phases. These phases have various patterns of biomechanical loading of the distal limb tissues. Contradicted to this, as a study by Thomson and Peterson (2008), 6 phases mentioned, that is preimpact, impact which can be divided into the primary and secondary impact, then followed by support, break and post-breakover.

The first phase, the preimpact phase is when the hoof at once touches the ground. The second stage, the impact stage, generally touches on how the collision of the mass of the horse with the limb when the hoof is fully on the track. The third stage is the support phase which

carries the maximum impact, where the weight of the body is shifted to the leg. The last two-phase, the breakover and post breaker is a phase when the hoof is lifted off from the ground. During the beginning of the breakover, the interphalangeal joint flexed, and the navicular bone has the most force due to the digital flexor tendon (Horan et al., 2021). The forces are then transferred to the ground, once the hoof touches the ground again, producing leg force, and then transmitted to the dorsal hoof wall and tip of the distal phalanx.

2.3 Radiography method to diagnose fetlock and hoof diseases.

Referring to Dyson and Murray (2007), diagnosing a lameness is based on the ability to produce a precise clinical examination, locate the cause of pain, high-quality diagnostic imaging, understand the result interpretation and the impediment of each method used, also to be able to correspond all the information.

The first step to diagnosing lameness is by observing the standing or moving horses, with a clinical examination of the system structure, manipulation to elicit any pain response as in the flexion test and local anaesthetics of the nerves from the distal to proximal joints. (Dik et al., 2015). Dyson (1989) supported that after localizing the source of pain, further examination can be done such as radiograph, ultrasound, magnetic imaging resonance and scintigraphy. Even so, radiography continues to be the primary imaging method for equine joints. Because underlying joint diseases are common, radiography is also the preferred modality for pre-purchase exams on horses, which translates to anticipating the likelihood of lameness (Dik et al., 2015)

For the radiography of the fetlock joint, although the four standard radiographic (lateromedial, dorsopalmar/plantar, dorsolateral-palmar/plantaromedial oblique and dorsomedialpalmar/plantarolateral oblique) are frequently thought of as being relatively enough, additional projections are occasionally needed for diagnosis. Radiography is the primary imaging technique used to assess bony structures, but it has significant drawbacks due

to the superimposition of bony structures and the lack of separation between soft tissues. (Butcher, 2001). The importance of these views can be seen based on the article by Dyson and Murray (2007), 36% of horses' fracture was only visible in a radiographic image of the distal phalanx that was either dorsoproximal-palmaromedial (DPr-PaMO) or dorsomedial-palmarolateral (DM-PaLO), while the other 14% of the total had fractures that could only be seen on the right oblique view or a palmaroproximal-palmarodistal oblique (PaPr-PaDiO) view. They also added that the dorsal articular borders of the distal interphalangeal joint can be evaluated to their fullest potential when using flexed oblique views. Because some anomalies involving the fetlock are frequently detected in horses with desmitis of the branches of the SL, a radiographic examination should be done to assess the proximal sesamoid bones and the distal aspect of the second and fourth metacarpal/metatarsal bones. (Butcher, 2001).

According to Sherlock and Parks (2013), in the radiography of the hoof, routine radiographs such as the lateromedial, horizontal dorsopalmar, and dorsal 45° proximal palmarodistal oblique views should be taken. This statement is supported by Dik et al., (2015), as they stated that the "gold standard" from which diagnosis and prognosis evaluation are regularly made is the lateromedial radiographic image, especially if the horse is suspected of laminitis. Particular focus should be placed on the frog's central and lateral sulci's cleanliness as well as the angles of the bars (Sherlock and Parks, 2013). The horse has to preferably be standing squarely on 2 blocks of identical height for each lateral and horizontal dorsopalmar radiograph to encourage even weight-bearing on each limb. The metacarpus/metatarsus have to be perpendicular to the floor and parallel to every different due to the fact the everyday anatomical relationships among the hoof capsule and distal phalanx and the phalanges may be altered if the horse isn't status this way. Radiographs of the contralateral limb have to additionally be received even in unilaterally affected horses and, in a few cases, it could be vital to assess all four limbs radiologically.

2.4 Reported radiographic fetlock and hoof diseases.

Musculoskeletal diseases are known to be the most common reason to cause injury to horses, to an extent could lead to fatality. According to Clegg, P.D (2011), musculoskeletal injuries are known to affect by causing a disruptive change in tissue as in muscle, tendon, ligament, cartilage or bone, or any compound of these. This is then contradicted by Dik et. al (2015), where 75% of equine disease came from race-induced injury, which is an orthopaedic disorder, followed by cardiovascular disorders and respiratory disorders.

Based on the study of cutting horses from the United States in 2019 by Swor et. al, the most reported case of musculoskeletal problems would be subchondral bone cysts with 50% of the horses affecting the hindlimbs. This is then followed by osteoarthritis of the distal tarsal joints (30%) affecting the hindlimbs, navicular pain (26%) affecting the forelimbs, and the suspensory ligament desmopathy (35%) affecting forelimbs and hindlimb equally. Laminitis, that is being diagnosed by radiograph, is reported to be found most likely in hindlimbs with only 5%. Similarly, as compared to a study by Agass (n.d), the current estimation of laminitis in horses would be ranging from 1.5-34%. This data can also be supported by a systemic review done by Wylie (2011), where according to the two top-notch studies on the general horse population, laminitis affects 1.5% to 23.8% of animals.

Proximal sesamoid bone fracture is also one of the common musculoskeletal problems that can be seen in horses. A post-mortem done in the United States by Schnabel and Redding in 2016, found that 41.5% of horses are diagnosed with biaxial fractures of the proximal sesamoid bone and 80% of it is from the forelimb). Proximal sesamoid bone can be further categorized into the type of fractures (apical, mid-body, basilar and abaxial) and the location of it whether it is in the articular region or non-articular region. Speaking of proximal sesamoid bones, they are also at risk of being diagnosed with sesamoiditis. A study has shown that in a population, 93% of the horses were affected with sesamoiditis. (McLellan & Pelvin, 2013).

In a study conducted in Prince Edward Island, Canada in 2021 by Rouette et. al, they categorized the musculoskeletal disease into three groups. The soft tissue group, where most of the injury occurs at the superficial digital flexor tendon (38%), followed by the desmopathy of the suspensory ligament (25%) and deep digital flexor tendon (12%). The bone category has the sesamoid bone being the most affected where sesamoiditis has a percentage of 43% and sesamoid fracture at 29%. PI fracture is also observed at 14%. Lastly, the joint group the fetlock joint that was affected has a percentage of 50%.

According to a study by Cornell University in New York that has been done in Thoroughbred racehorses, the most common occurrence of musculoskeletal disease that can be seen is a fracture. The most common location for having the fracture is at the metacarpal bone (16%) followed by the third phalanx (7%), sesamoid bone (6%), fetlock joint (6%) and carpus (8%) (Mohammed et al., 1991). Racing thoroughbreds frequently develop fractures (Riggs, 2002). A serious musculoskeletal injury has been linked to as many as one out of every 700 racing starts; the majority of these injuries included fractures. The yearly fracture incidence in a sizable group of Thoroughbreds training for races was 9%. Another finding that can be found is that the front limbs were the site of the majority of injuries (47% left and 41% right, respectively). PI chip fractures is also one of the common occurrences that can be seen in Thoroughbred racehorses (COLÓN et al., 2010). Based on their study, the left forelimb are more prone to be affected, followed by the right forelimb, left hindlimb and right hindlimb with percentage of 51%, 37%, 7% and 5% respectively.

Another musculoskeletal disease that can be diagnosed by radiograph is the Tropical Joint Syndrome. Referring to the article by Shaw & Rosanowski (2019), Tropical Joint Syndrome was diagnosed in 79 horses based on the case definition, among approximately 4750 horses in training at the Singapore Turf Club between 2008 and 2015, for an incidence of 16.6 per 1000 horses in training. They also added that the prevalence of Tropical Joint Syndrome in

Hongkong was between 1%-10%. In comparison to a recent investigation in the equestrian horses in Western Libya by Abushhiwa et al., (2022), 35% of horses had hard, non-painful swelling on the dorsal aspect of the fetlock, as well as joint stiffness during flexion. The swelling was bilateral in 19 of them.

A retrospective study was also done in studying the radiographic abnormalities in repositories for Thoroughbreds at yearling sales in Japan. As reported by Miyakoshi et al., (2017), the most radiographic abnormalities in the fetlock of the forelimbs would be present of the notch at the proximal aspect of the MCIII sagittal ridge with a percentage of 24.3%. When it comes to the proximal sesamoid bones of the forelimb, the vasculitis of the sesamoid bone can be seen with the greatest percentage of 62.3%.

3.0 METHODS AND MATERIALS

3.1 Data Retrieval

A retrospective study on radiographic hoof and fetlock diseases of horses presented at Selangor Turf Club (STC) Equine Hospital during the period from 1st January 2019 to 30th August 2022 was retrieved and cross-checked with STC veterinary officers. Radiographic records were accessed through the computerised database FUJIFIL FCR XG-1 and radiographs were taken using MIKASA HF8015+DLP.

Data were picked and collected when fetlock and hoof radiographic diseases is found. They are then grouped into two locations which are the fetlock and hoof. The diseases are then continue grouped into diseases. Other data that are being collected is the number of cases, location of the disease, limbs that were affected and radiographic views that were taken to diagnose.

To be included as a case, any diseases that can be visible through the radiographic at the fetlock, either periarticular or intra-articular are included. Recurrent injuries at the same

location or any re-examination of the horses were not included as separate events when considered as an occurrence of disease types. Other anatomical structures other than the fetlock and the hoof are not included, such as the splint bone. Another exclusion factor being added was the age and gender due to the inaccessibility of most of the horses.

3.2 Statistical Analysis

The data regarding the number of cases, location of disease, types of disease, and limbs affected were presented in graphs, tables, and bar charts, using descriptive analysis. Among 500 cases available, 226 cases were chosen. There were 178 radiographic fetlock diseases and 43 radiographic hoof diseases from 1st January 2019 to 30th August 2022. After that, it is further classified into the location of the disease. The data is then tabulated in Microsoft Excel.

4.0 RESULTS AND DISCUSSION

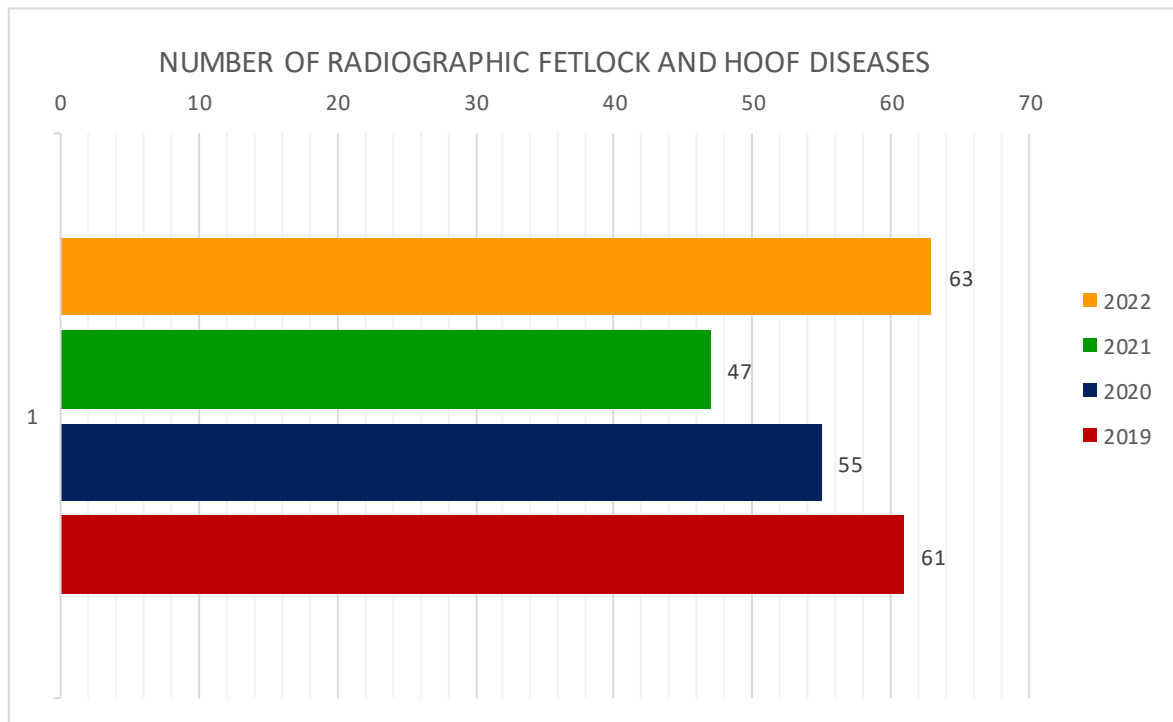


Fig. 1 No. of cases of radiographic fetlock and hoof diseases for 4 years of study period

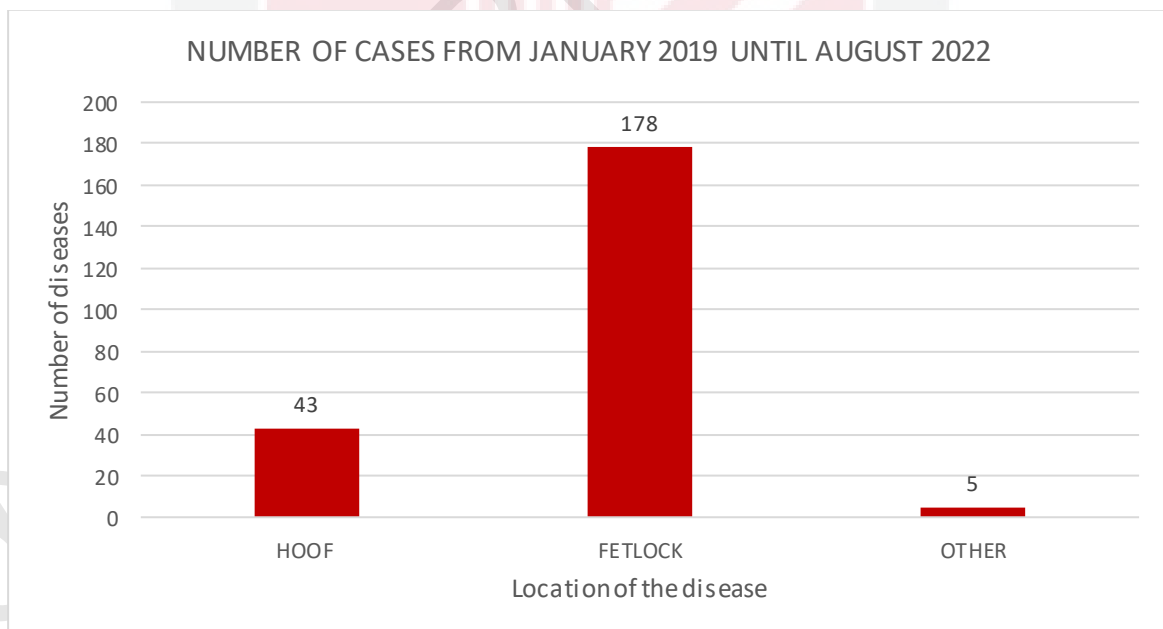


Fig. 2 No. of cases categorized according to radiographic fetlock and hoof diseases for 4 years of study period

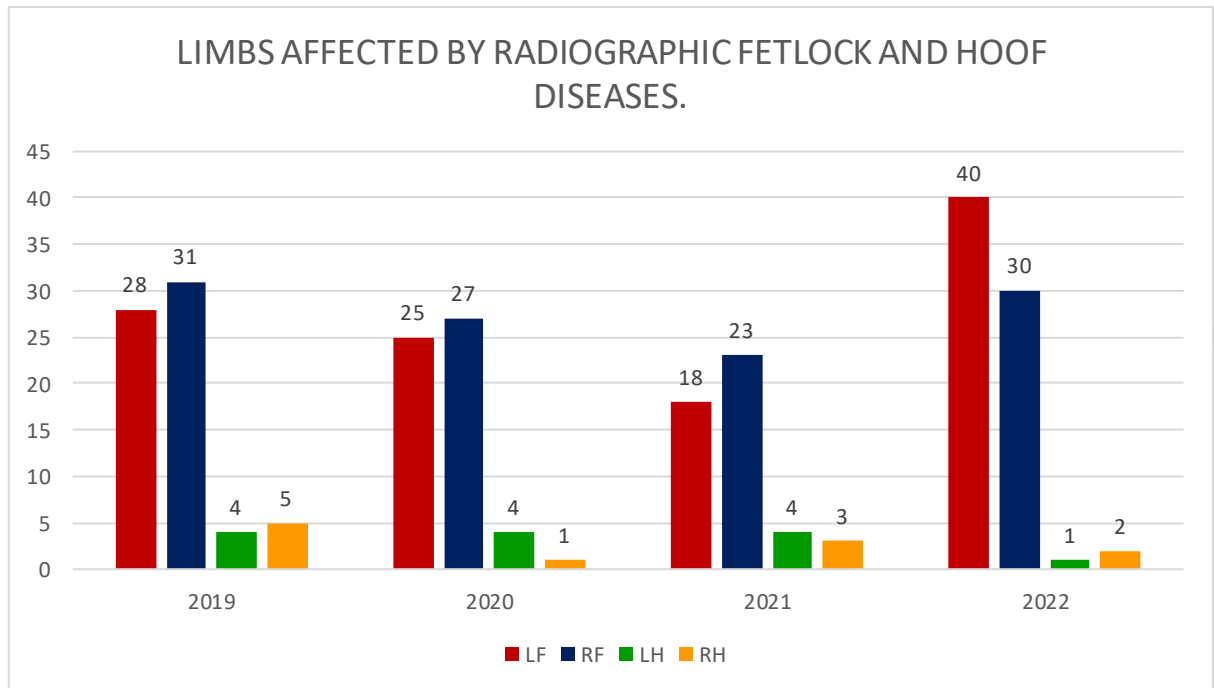


Fig. 3 No. of cases categorized according to limbs affected by radiographic fetlock and hoof disease for 4 years of study period. LF = Left forelimb, RF = Right forelimb, LH = Left hindlimb, RH = Right hindlimb

Among the 500 cases collected, 178 are diagnosed with radiographic abnormalities of the fetlock while 43 of them are being diagnosed with radiographic abnormalities of the hoof. The others are excluded as they involved the splint bone, which is located proximal to the first phalanx. Generally, based on Figure 3, the forelimbs are more affected compared to the hindlimbs. This statement is similar to a study in Britain where more than 90% of musculoskeletal diseases documented in a recent longitudinal analysis of racecourse injuries in Britain included the limbs, and more than 80% of these injuries were to the forelimbs (Perkins et al., 2005) The reason for this outcome might be since the forelimbs bear between 60 and 65 percent of the weight of the horse and experience higher load rates than the rear limbs, they are where most lameness manifests itself. Based on Back et al., (1995), another reason that can be justified this finding is more kinematic stress is placed on the distal section of the forelimb than the distal portion of the hind limb.

4.1 Fetlock

Table 1 Radiographic fetlock diseases collected at Selangor Turf Club for 4 years of study period

Diseases	N	%
Fracture	64	18.6
Desmopathy of the suspensory ligament	54	15.7
Dermatitis of the suspensory ligament	5	1
Sesamoiditis	11	3
Degenerative Joint Disease (DJD)	61	17.7
Tropical Joint Syndrome	31	9
Vilonodular Synovities	5	1
Synovitis	10	3
Capsulitis	18	5
Erosion of the Distal/Proximal MCIII	35	10.2
Osteochondrosis	9	3
Calcification of Suspensory Ligament	17	5
Desmopathy of the Collateral Ligament	13	4
Others	7	2
TOTAL	344	100

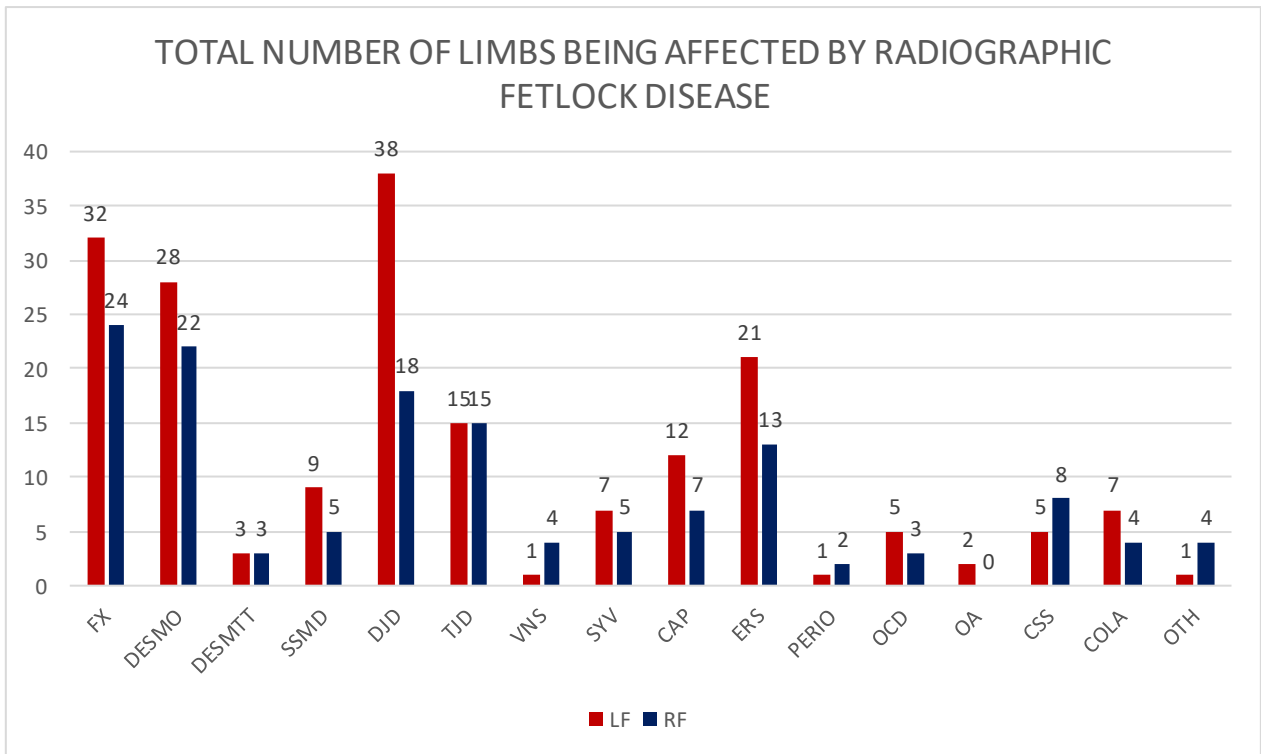


Fig. 4 No. of cases categorized according to limbs affected by fracture of the fetlock joint for 4 years of study period. FX = Fracture, DESMO = Desmopathy, DESMTT = Desmatities of the suspensory ligament, SSMD = Sesamoidities, DJD = Degenerative Joint Disease, TJD = Tropical Joint Syndrome, VNS = Vilonodular Synovities, SYV = Synovities, CAP = Capsulities, ERS = Erosion of the Distal/Proximal MCIII, OCD = Osteochondrosis, CSS = Calcification of Suspensory Ligament, COLA = Desmopathy of the Collateral Ligament, OTH = Others

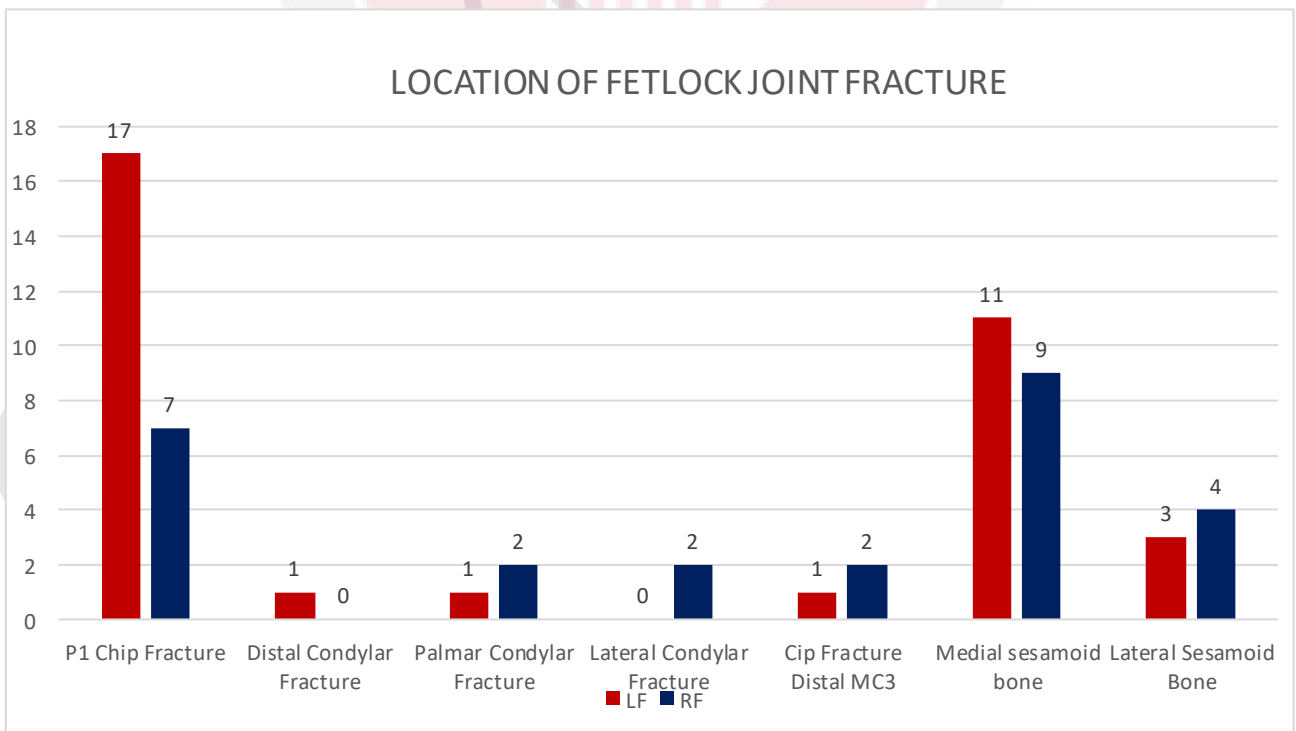


Fig. 5 No of cases of sesamoiditis categorizing by the limbs being affected

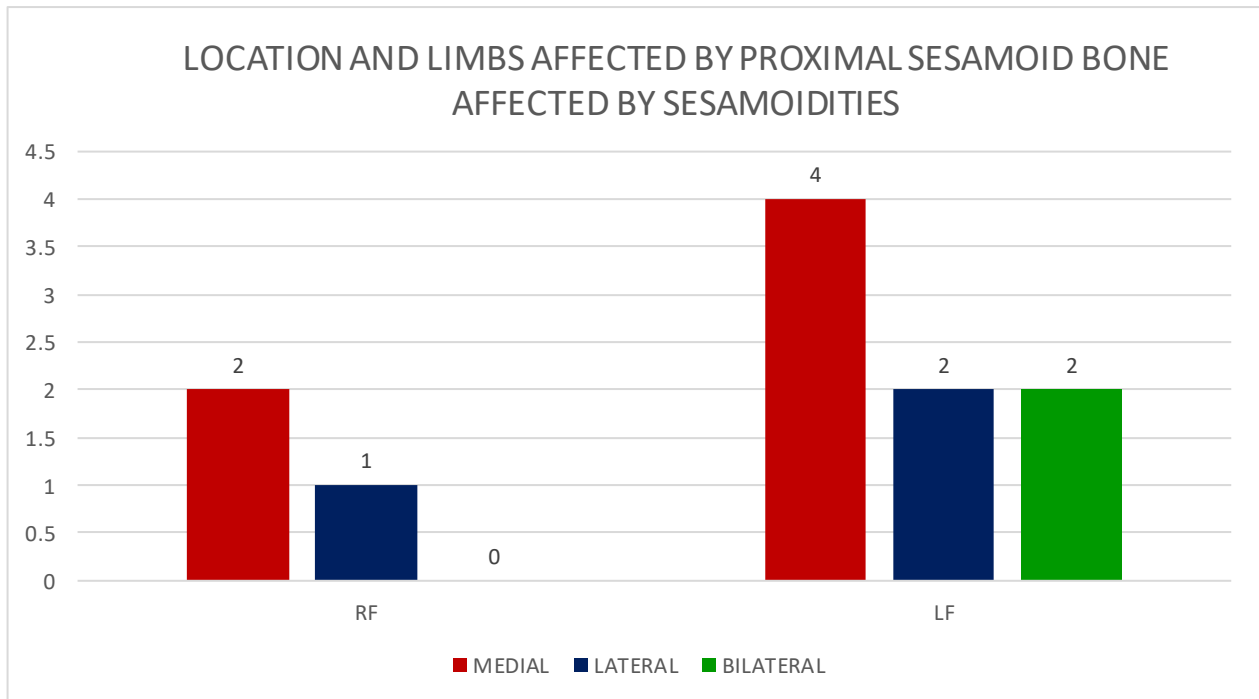


Fig. 6 No. of cases categorized according to limbs affected by sesamoiditis and location of proximal sesamoiditis being affected for 4 years of study period. RF = Right forelimb, LF = Left forelimb

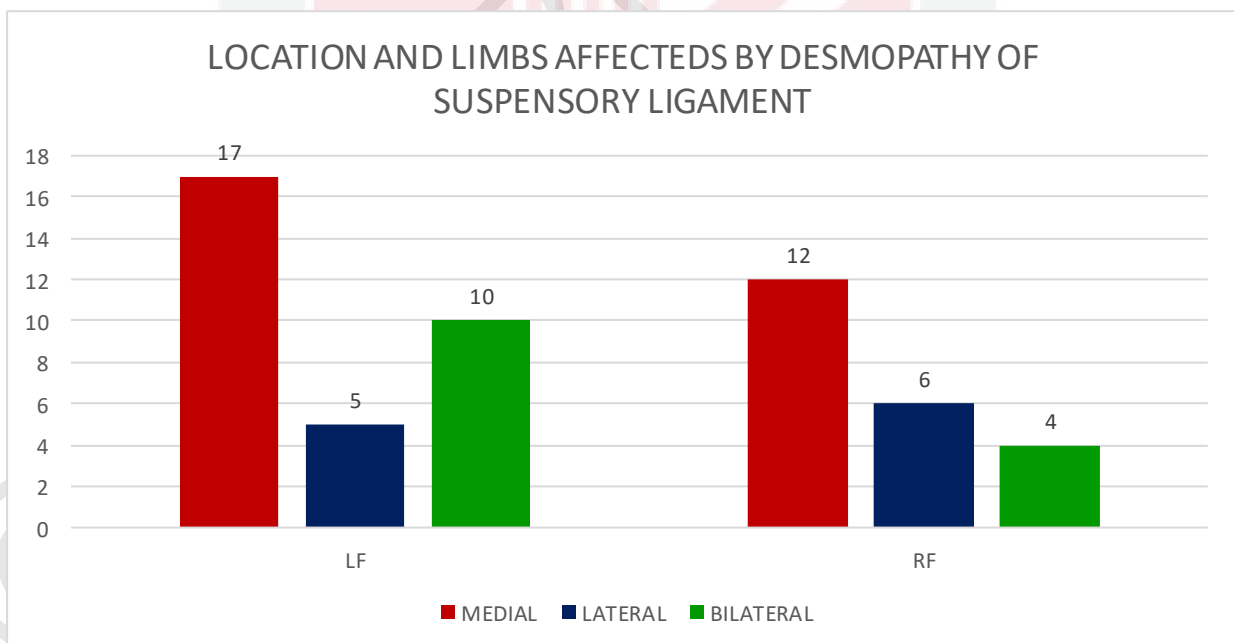


Fig. 7 No. of cases categorized according to limbs affected by desmopathy suspensory ligament and suspensory ligament branches for 4 years of study period. LF = Left forelimb, RF = Right forelimb

178 horses being affected by radiographic fetlock diseases. Among them, 344 cases were obtained and 14 pathological diseases were diagnosed. Based on Table 1, the most diagnose radiographic fetlock disease that can be seen would be the fracture of the fetlock with a percentage of 18.6%. The second most common occurrence of radiographic fetlock disease is the degenerative joint disease (DJD) (17.7%), followed by the insertion desmopathy of the suspensory ligament (15.7%), the erosion of the distal MCII and proximal PI (10.2%) and Tropical Joint Syndrome (TJS) with the percentage of 9%. Other diseases such as synovitis, capsulitis, osteochondrosis (OCD), calcification of the suspensory ligament, dermatitis of the suspensory ligament and sesamoiditis did not make up more than 5% of total cases. This discussion will cover the top 5 cases presented.

Overall, the left forelimb is more affected compared to the right forelimb (Fig. 4). The fetlock joint of the left forelimb is known to be due to the anticlockwise and clockwise race route. In Selangor Turf Club, the race is practised to follow the anticlockwise route, causing the weight to be distributed to the left forelimb more compared to the right forelimb. An article from Colon et al., (2010) supports this statement where the constant left-hand turns tend to distribute the loads unevenly, increasing the stress on the left limb. This is likely related to the practice of training and racing counterclockwise in North America. This study can also be supported by a study in Gauteng, South Africa, where the races held there are in the clockwise direction and the horses are found to be affected at the right forelimb as the horses will be lead with the right forelimb during the turn causing fatigue (Spargo, 2019).

Fractures in the fetlock joint can be categorised by their location. In this study, the most common location of fracture would be the PI chip fracture, followed by the medial proximal sesamoid bone fracture and lateral proximal sesamoid bone where the percentage is 40%, 33% and 12% respectively. The distal, lateral and palmar condylar fracture together with the chip fracture of distal MCIII contributed <5% of total fracture occurrence.

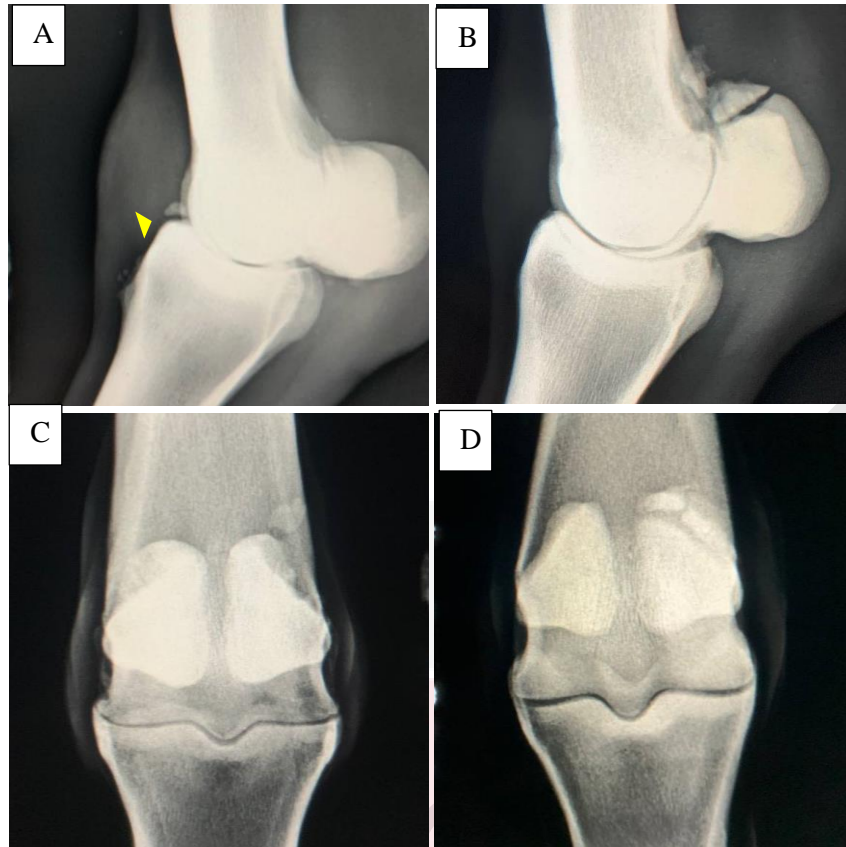


Fig. 8 Fractures of the fetlock. A = PI chip fracture. Note the presence of the chip (yellow arrowheads). B = Apical fracture of the sesamoid bone. C = Fracture of the lateral sesamoid bone. D = Fracture of the medial sesamoid bone.

According to Colon et al., (2010), dorsoproximal first phalanx osteochondral fragmentation (PI chip fractures) is a frequent occurrence in Thoroughbred racehorses. When the fetlock joint is overextended during rapid exercise, the dorsoproximal eminence of PI repeatedly strikes the third metacarpal/metatarsal bone, causing impact injury and fragmentation of PI. For the proximal sesamoid bone fracture, the medial side is more prominent compared to the lateral site. This could again be correlated with the anti-clockwise race route that is the practice in Selangor Turf Club. Even so, this is contradicted by Schnabel & Redding (2016) where it is expected for Thoroughbreds horses to have a medial sesamoid fracture of the right forelimb. They further explain that the medial side is more predisposed to fracture is because compared to the lateral side, the medial fetlock is much heavier.

The factor that contributed to the fracture of the proximal sesamoid bone is most likely due to the hyperflexion of the leg during the end of a high-intensity exercise (Schnabel & Redding 2016). This is further explained by Kristoferson et al., (2010), where the strain on the suspensory mechanism and, consequently, the stresses on the proximal sesamoid bones, may be affected by the interface between the distal limb and the racing surface. The stresses on the superficial digital flexor tendon during the stance phase of the stride, in the trot at high speed, have been demonstrated to be influenced by the track surface and because the suspensory apparatus and superficial digital flexor tendon are loaded at the same time during the stance phase, the stresses on the suspensory apparatus are probably impacted similarly to the superficial digital flexor tendon. The proximal sesamoid bones are compressed by pressures acting on the dorsal articular surface of the sesamoid bone against the palmar side of the third metacarpal condyles during hyperextension of the fetlock joint while being under tension by the ligamentous section of the suspensory apparatus, which includes the suspensory ligament and distal sesamoidean ligaments.



Fig. 9 Degenerative Joint Disease concurrent with PI chip fracture, synovitis, and capsulitis

Degenerative Joint Disease (DJD) is the second-most radiographic fetlock disease seen in this study. By definition, DJD is known to be a compilation of diseases such as synovitis and capsulitis where it is characterized as a group of disorders that cause deterioration of the joint leading to the changes of the bone, joint and soft tissue (McIlwraith and Van Sickle, 1981).

Based on the data collected and associating the definition with it, synovitis and capsulitis are not much to be compared to the DJD. One of the reasons for this is might to the diagnosis of DJD in the study is done when the horses are in a subclinical state or the early stages, thus by using a radiograph, the early diagnosis has been done. Even so, based on a study by Larry (2019), physical debris particularly bone debris such as a chip could eventually lead to DJD. Hence, this explains the high occurrence of PI chip fracture. Of all the limb joints in racing horses, the fetlock joint displays the most distinct degenerative and traumatic lesions. The horse's limb shape may change as a result of improper shoeing, altering the pressures acting on the joint surfaces (Orth, 2014). Larry (2019) also added that the loss of proteoglycan that acted as a lubricant in the joint and excessive force in the joint could cause the formation of DJD.

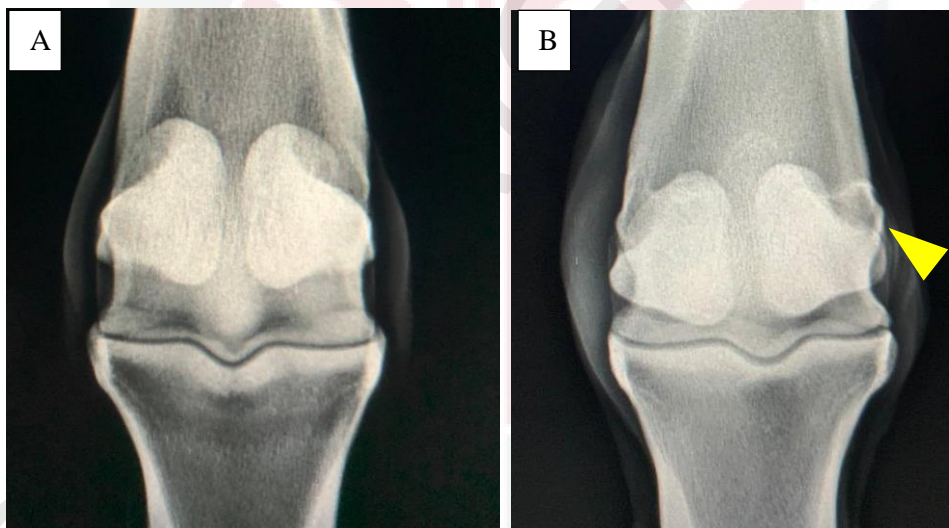


Fig. 10 Insertional Desmopathy of Suspensory Ligament. A = Insertional desmopathy of the suspensory ligament at the medial side. B = Insertional desmopathy of the suspensory ligament at the lateral side. Note the increase opacity at the dorsal region of the lateral sesamoid bone. (yellow arrow)

The suspensory ligament and the proximal sesamoid are related to each other during the biokinetic mechanism of the leg. “A suspensory ligament desmopathy might be may account for the mild increase in vascular channels seen as well as the irregular borders of the proximal sesamoid bone. (Furniss, 2011)”. This statement also further support by Schnabel et al. (2006) as it mentioned that the pathology cause of proximal sesamoid bone is correlated

with the failure of suspensory apparatus and also by McLellan & Pelvin (2013) where according to reports, radiological evidence of sesamoiditis is a sign that the attached suspensory branch has previously been injured. Thus, the presence of insertional desmopathy of the suspensory ligament should act as a sign for sesamoiditis.

In this study, the sesamoiditis is prominent in the left forelimb and the medial side (Fig. 6), and it is the same goes for the location of the insertion desmopathy of suspensory ligament are more prominent towards the left forelimb and the medial branch (Fig. 7). This is similar to a study by Fairburn (2016) in California where in a post-mortem study of Californian racehorses found that moderate lesions were more common in the medial compared to the lateral suspensory ligament branch. The suspensory ligament may potentially sustain a spontaneous traumatic or fatigue injury during training that is unrelated to prior suspensory/sesamoid damage (McLellan & Pelvin, 2013)



Fig. 11 Erosion of the distal MCIII and proximal PI. Note the translucency at the sagittal ridge (yellow arrow)

“The erosion of the distal MCII and proximal PI is known as translucency at the proximal and distal sagittal ridge of a distal MCIII and PI (Miyakoshi et.al., 2017).” The fetlock joint articulations are the most often afflicted ones. Horses who develop erosion, are more

prone to be diagnosed with osteochondrosis. There are many factors why this disease occurs. The first would be the genetic factor where it is mentioned in the article that horses that are fast-growing with the presence of SNP BIEC2-808543 are associated with osteochondrosis. Miyakoshi et al., (2017) further stated that Thoroughbreds have a prevalence of 7.2-14.9% compared to South German Coldbloods (53.9%), based on the radiographic survey findings. Other than that, Naccache (2018) stated that the ischaemia of the growth cartilage and alterations in the production of type II collagen were postulated as key pathogenesis-related variables. Besides that, the effect of insulin in growing cartilage may be to increase chondrocyte survival or to restrict differentiation. These alterations might be due to the nutritional factor whereby high glucose intake will cause hyperinsulinemia. By influencing other hormones like thyroxine, hyperinsulinemia may affect chondrocyte maturation, resulting in altered matrix metabolism, faulty mineralization, or altered cartilage growth.

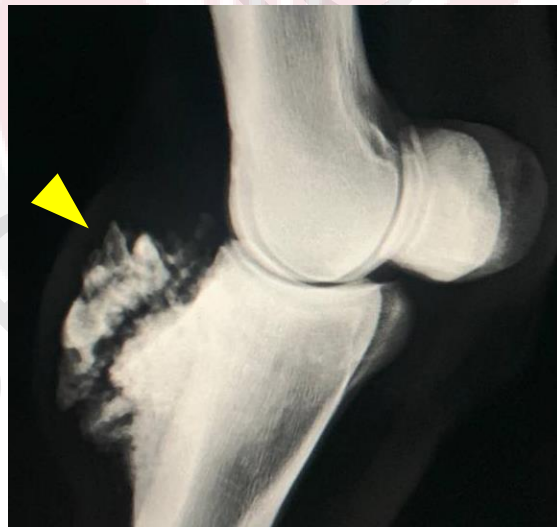


Fig. 12 Tropical Joint Syndrome. Note the exostosis of the PI (yellow arrow)

There is not much study done in Tropical Joint Syndrome, maybe because it does not cause any pain or cause lameness and race performance. The definition for this disease is the formation of extra-articular exostosis at the proximal PI (Shaw & Rosanowski, 2019) The lesion would be focussing outside of the joint, causing a periosteal reaction involving lateral

digital extensor tendon insertion. There are three main suggestion on why this syndrome could occur which is the avulsion of the lateral digit extensor, the tearing of the joint capsule and lastly climate factor which is more prominent in a tropical country, hence the name. 9% of the horses presented with radiographic fetlock disease were affected by this, which is higher compared to Hong Kong (1%), which is known to be a seasonal country. However, this is not enough to speculate as many factors could lead to this factor such as race tracks. This is suggested by Mohamed (2021), where the surface of the race track could influence the impact of the fetlock joint thus causing avulsion towards the lateral digit extensor. The impact of the season may also be partially attributed to environmental factors like wind, temperature, and rainfall, all of which may significantly alter the properties of the track surface (Perkins, 2005). Another factor that is mentioned and suggested in the same article is that age might be contributing factor as a new bone formation is different at different ages.

4.2 Hoof

Table 2 Radiographic hoof diseases collected at Selangor Turf Club for 4 years of study period

Diseases	N	%
Sidebone	3	7
Laminitis	10	22
Navicular Disease	3	7
Pedal osteitis	3	7
Foot Abscess	4	9
Subsolar Hematoma	3	7
Fracture	5	11
Pastern Joint Disease	6	13
Coffin Joint Disease	3	7
Insertional Desmopathy of the Deep Digital Flexor Tendon	1	2

Trauma	1	2
Other	3	7
TOTAL	45	100

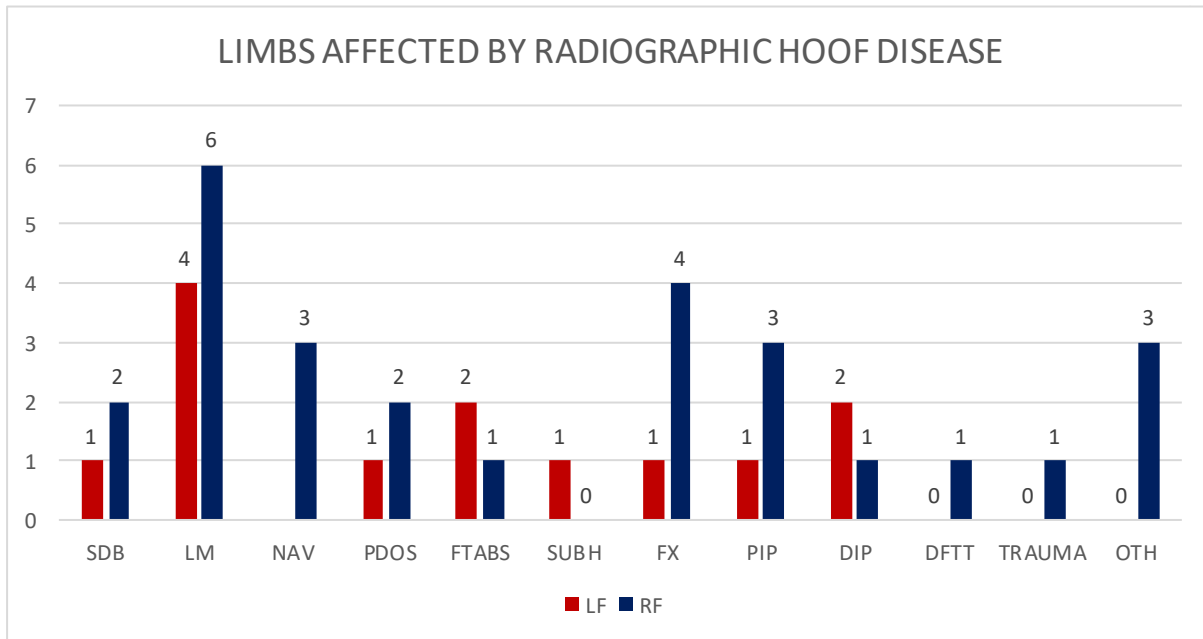


Fig. 13 No. of cases categorized by radiographic hoof diseases and hoof affected for 4 years of study period. LF= Left forelimb, RF=Right forelimb, SDB = Side bone, LM = Laminitis, NAV = Navicular Disease, PDOS = Pedal Ostitis, FTABS = Foot Abscess, SUBH = Subsolar Hematoma, FX = Fracture, PIP = Pastern Joint Disease, DIP = Coffin Joint Disease, DFTT = Desmopathy of Deep Digital Flexor Tendon, OTH = Others.

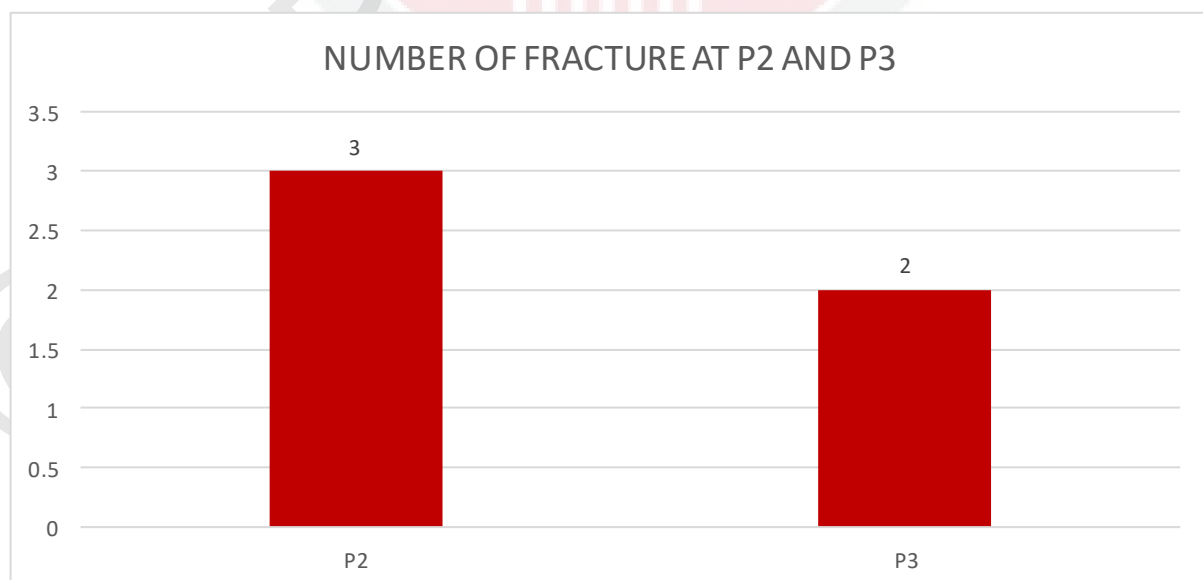


Fig. 14 No. of cases categorized by location of fracture of the hoof for four years of study period.

43 horses being affected by radiographic fetlock diseases. Among them, 45 cases were obtained and 11 pathological diseases were diagnosed. Based on the data in Table 2, laminitis is the most disease found, with a percentage of 22%. This is then followed by pastern joint disease (13%) and fracture (11%). Other diseases such as sidebone, navicular disease, pedal osteitis, foot abscess, subsolar hematoma, coffin joint disease, insertional desmopathy of the deep digital flexor tendon and trauma contributed to <10% of the total occurrence. Hence, we will be discussed the top 3 diseases presented.

Compared to the fetlock joint where the left forelimb has a higher occurrence of being affected by the disease, the hoof is more towards the right forelimb. This might be because the hoof diseases are not caused by any mechanical factors. This is further proven by Gustas et al., (2004), where the biomechanics of the hoof between the forelimbs and hindlimbs has no significant difference.

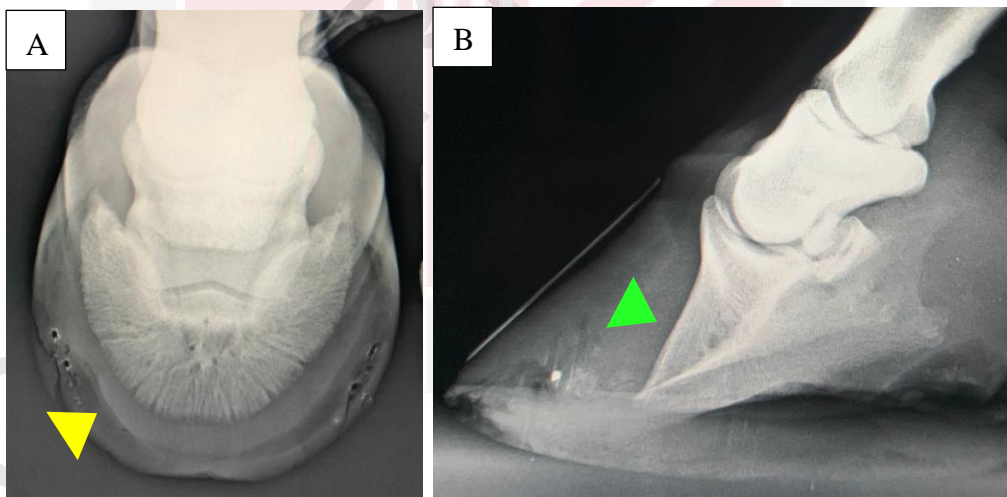


Fig. 15 Laminitis. (A) Acute laminitis. Note the increase opacity at the toe of the hoof (yellow arrow) (B) Chronic laminitis. Note the pedal bone rotation (green arrow)

Typically, when it comes to laminitis, there are 3 major reasons. Agass (n.d) stated that sepsis-associated, endocrinopathies and increased weight being on a single limb could cause laminitis. Sepsis-associated laminitis is known to be due to inflammation and often causes by systemic inflammatory response syndrome (SIRS). It commonly occurs after a severe chronic

gastrointestinal disease. Endocrinopathies are most likely due to an imbalance of hormones in the body. In the case of horses, a high level of insulin could affect the vasculature of the horse. Weight-bearing laminitis usually causes ischemic of the blood vessels. All these factors will eventually lead to the disturbance of the lamellae, causing the displacement of the distal phalanx within the hoof capsule, often leads a sinking. Laminitis can be diagnosed by radiograph when there is a rotation or dislocation of the pedal bone (Figure 15(B)). In this study, based on figure 15 (A), it is known as acute laminitis, as only the pooling of blood is seen.

For this study, the occurrence of laminitis is more prominent towards the right forelimb (Fig. 13). This might be due to the third reason mentioned earlier, where since most of the horses presented are affected with left forelimb (Fig.3), hence they tend to shift the weight to the right side, leading to weight bearing laminitis.



Fig. 16 Pastern joint disease.

The pastern joint disease or known as the proximal interphalangeal disease is the second most common occurrence of radiographic hoof diseases. Pastern joint disease is clinically the same as DJD previously discuss, with the definition of loss of cartilage over time and periarticular new bone growth (Knox & Watkins, 2016). The pastern joint is a low motion,

hence high load bearing on this particular joint biomechanically could lead to a lot of damage and inflammation.



Fig. 17 Fracture of the PIII. Note the fine line fracture (yellow arrow)

When it comes to fracture, the PII has a higher occurrence compared to PIII (Fig. 14). Based on Figure 13, the left and right forelimb does not have much of a difference. This might be because most of the fractures that occur in the hoof are self-inflicted. This statement is supported by Kidd (2011), where pastern bone fractures are due to collisions with hard objects or kicking walls that can hurt both the front and back foot and by Ryan and Gary (2011) where lunging or trauma is one of the most common factors. Other reasons that may contribute to this cause is that it may be typically results from an acute process requiring a sudden stop or acceleration, direction shift and so on such as dressing horses or polo horses (Torzewski & Mihaly, 2008). Once this occurs, physiological limitations are commonly exceeded, which can lead to the onset of diseases.

5.0 CONCLUSION

In general, both fetlock and hoof radiography diseases are presented at Selangor Turf Club, with a high occurrence. The most common disease is the fracture of the fetlock with a percentage of 18.6%, with PI chip fracture being the most preferable location 40%. The second most common occurrence of radiographic fetlock disease is the degenerative joint disease

(DJD) (17.7%), followed by the insertion desmopathy of the suspensory ligament (15.7%), the erosion of the distal MCII and proximal PI (10.2%) and Tropical Joint Syndrome (TJS) with the percentage of 9%. Most of the diseases are predilated towards the left forelimb and the medial site. For the hoof, laminitis is the most common disease found, with a percentage of 22%. This is then followed by pastern joint disease (13%) and fracture (11%). The predilation of limbs affected would be on the right forelimb. The preliminary information should lead to an increased emphasis on the inspection and implementation of the examination.

6.0 RECOMMENDATIONS

It is recommended that further studies should be conducted on the type of age being affected, such as in Tropical Joint Syndrome disease. Other than that, since most of the diseases presented are correlated to one another, is it advisable to do an analytic test by using SPSS if there is any correlation between these diseases such as DJD and PI chip fracture or sesamoiditis and insertional desmopathy of the suspensory ligament. Other than that, using more than one modality such as ultrasound would help in diagnosing soft tissue injury more accurately.

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