UNIVERSITI PUTRA MALAYSIA

DIFFERENT JOINT SURGICAL PROCEDURES AMONG THOROUGHBRED HORSES AT PERAK TURF CLUB (PRTC) IN ASSOCIATION TO THE RACE PERFORMANCE FROM YEAR 2008 TO 2015

HIKMA HASHIQIN BINTI ABDUL HALIM

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It is hereby certified that we have read this project paper entitled, 'Different Joint Surgical Procedures among Thoroughbred Horses at Perak Turf Club (PrTC) in Association to the Race Performance from Year 2008 to 2015' by Hikma Hashiqin binti Abdul Halim. In our opinion, it is satisfactory in terms of scope, quality and presentation as partial fulfillment of the requirement for the course VPD 4999 - Project.

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DEDICATION

Specially dedicated to my late father,

beloved mother, siblings and my

significant other.

With lots of love.

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First and foremost, I would like to extend my sincere thanks and heartfelt gratitude to Allah S.W.T for His blessed in allowing me to complete this project successfully. To my family for their never ending love and care, solid support, sound advice and patience in raising her up to be for whom she is today. *You mean the world to me for without you, I would be nothing.*

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DIFFERENT JOINT SURGICAL PROCEDURES AMONG THOROUGHBRED HORSES AT PERAK TURF CLUB (PRTC) IN ASSOCIATION TO THE RACE PERFORMANCE FROM YEAR 2008 TO 2015

by

Hikma Hashiqin binti Abdul Halim

2016

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Co-Supervisors: Dr. Alistair Murdoch, Dr. Reza Sashi Singam and

Prof. Dr. Mohamed Ariff Omar

Locomotion problems and joint injuries are the main cause of early retirement in athletic horses. A retrospective study on cases of equine joint surgeries at Perak Turf Club (PRTC) from year 2008 to 2015 was carried out to define the occurrence and frequency rates in relation to the prognosis. Relationships between duration to first start and number of races after surgery, and frequency of lifespan races with its contributing factors were determined. Records were acquired from equine surgery log book in Veterinary Hospital PRTC and races performances were attained from the Malayan Racing Association (MRA) website. Twenty-five percent (218 joint surgeries out of 849 surgery cases) were identified within the 8-years period. Highest

occurrence of joint surgeries was arthroscopic surgery; 83 % (181/218 cases) with the utmost rate was at the right carpal joint (34 %). Carpal joint arthroscopic surgery contributed 81 % of the cases while fetlock joint was only 18 %. From 218 horses, 135 horses had at least one start after the surgery with the median number of days to the start was 180 days. Eighty-eight horses were identified to have successfully raced with median; 6 races and 3 horses recorded more than 30 races after the surgery. The life span average race was 15 years; 54 horses (25 %) had 16 races. There was a relationship between age group with different joint locations. As a conclusion, horses that underwent arthroscopic surgery have a good prognosis and it has the ability to restore racing capability of the horse with high number of races post-operative. The prognosis is contributed by age and lesion at different joint locations. Arthroscopic surgery is suggested to be the best treatment for joints.

Keywords: arthroscopic; arthrotomy; racing performance; prognosis

ABSTRAK

PROSEDUR PEMBEDAHAN SENDI YANG BERBEZA PADA KUDA THOROUGHBRED DI KELAB LUMBA KUDA PERAK BERHUBUNGKAIT DENGAN PRESTASI PERLUMBAAN DARI TAHUN 2008 HINGGA 2015

Oleh

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Sistem lokomotor dan kecederaan sendi adalah punca utama persaraan awal ekuin dalam sukan perlumbaan kuda. Tiada kajian pembedahan sendi dalam kalangan ekuin yang telah dilakukan di Malaysia untuk mengaitkan keberkesanannya melalui prognosis yang mana prestasi perlumbaan digunakan sebagai indikasi. Satu kajian retrospektif mengenai kes-kes pembedahan sendi kuda yang telah dilaksanakan di PRTC dari tahun 2008 sehingga 2015 telah dijalankan. Kajian ini bagi menentukan kadar frekuensi dan kejadian berhubung dengan prognosis. Hubungan antara tempoh untuk perlumbaan pertama dan

bilangan perlumbaan selepas pembedahan, serta kekerapan perlumbaan dalam jangka hayat dengan faktor penyumbang seperti umur dan distribusi lesi pada sendi yang berlainan telah ditentukan. Rekod telah diperolehi daripada buku log pembedahan kuda di Hospital Veterinar PRTC dan prestasi perlumbaan telah dicapai daripada laman web Malayan Racing Association (MRA). Sebanyak 218 pembedahan sendi daripada 849 kes-kes pembedahan sepanjang 8 tahun dengan kejadian sebanyak 24.68 %. Frekuensi tertinggi pembedahan sendi ialah pembedahan artroskopik; 83.0 % (181/218 kes) dengan kadar tertinggi adalah di sendi karpal (34.30%). Pembedahan arthroskopik di sendi karpal menyumbang 81 % daripada kes-kes manakala sendi fetlok hanya 18 %. Daripada 218, 135 kuda mempunyai sekurang-kurangnya satu permulaan selepas pembedahan dengan bilangan median hari untuk permulaannya ialah 180 hari. Terdapat 60.1%. kuda yang berusia empat hingga lima tahun. Lapan puluh lapan kuda yang dikenalpasti telah berjaya berlumba dengan median; 6 perlumbaan dan 3 kuda mencatatkan lebih daripada 30 perlumbaan selepas pembedahan. Purata perlumbaan sepanjang jangka hayat adalah 15; 54 kuda (24.8 %) mempunyai 16 perlumbaan. Terdapat hubungan antara kumpulan umur dengan lokasi sendi yang berbeza. Bagi pembedahan artrotomi, bilangan perlumbaan selepas pembedahan adalah bergantung dengan lokasi sendi. Kesimpulannya, kuda yang mengalami pembedahan artroskopik mempunyai prognosis yang baik dengan jumlah perlumbaan lebih tinggi selepas pembedahan berbanding artrotomi. Prognosis disumbangkan oleh umur dan lesi di lokasi sendi yang berbeza. Pembedahan artroskopik boleh menjadi rawatan yang terbaik untuk sendi.

1.0 INTRODUCTION

Disease of locomotion system and joint injuries are the most important cause of early retirement in athletic horses (Reed, *et al.*, 2010). These will then lead to lameness and become the primary reason of lost training days for racehorses. Most joint injuries involve the carpal, metacarpophalangeal (MCP) and metatarsophalangeal (MTP), which are also known as fetlock joint in focal areas which sustain repetitive impact loads.

Keyhole surgery of joints (arthroscopy) is which procedure in human medicine. The techniques and equipment have rapidly advanced over the last 25 years and arthroscopy has now also become commonly performed in horse practice. Horse joints by their vary size are ideal candidates for the keyhole surgery. It is also preferred by veterinarian because of the significantly reduced incidence of post-operative infection, and reduces the need to bandage the limb following the surgery. Most equine orthopedic surgeons accept that equine arthroscopy has revolutionized joint and tendon sheath surgery in the horse.

Walmsley (1997) states that arthroscopy is much less invasive and allows a more detailed examination of accessible structures of the joint and would therefore serve as a preferred route for internal fixation. Ramzan and Palmer (2010) explained that two common fracture sites in Thoroughbreds racehorses are the third metacarpal/tarsal (MC3/MT3) condylar fractures and sagittal fractures of the

proximal phalanx (P1), which constituted 14.5 % and 10.4 % of all racehorse injuries, respectively in one cohort study done in UK.

When doing surgery in athletic horse, the optimal objective is returning it to athletic soundness. A return to athletic soundness can only occur if the joint is not too seriously damaged by the original injury or by the surgeon. The decision to invade the joint surgically, involve the selection of the surgical technique to be used. Currently, surgical techniques for joint problems have gone through considerable sophistication and the two greatest advances in equine orthopedic surgery are internal fixation of fractures and arthroscopic surgery (McIlwraith & Bramlage, 1996). Familiarity and experience with arthroscopic techniques has made arthroscopic aided fracture repair of articular fractures state of the art. Direct examination of fracture reduction, ability to treat additional articular disease simultaneously during fracture repair and avoiding the morbidity associated with arthrotomy has improved outcomes.

This project was conducted to allow us to have a better understanding on the distribution of specific anatomical locations of horses that are more predispose to any skeletal or joint related problems due to intensive training. Besides, this was done to reduce the communication barrier between the veterinarian and the trainer in order to convince the successfulness of joint surgical procedure as to prevent any early retirement of racing career or humane euthanasia of the horse.

The objectives of this study are:

1. To identify the occurrence of different joint surgical procedures in Perak Turf Club.
2. To identify the racing performance of the affected horse post-operation for each procedures.

2.0 LITERATURE REVIEW

2.1 Arthroscopic surgery

2.1.1 Principle

The principle goals of the arthroscopic surgeon are reconstruction of articular surfaces or congruity, or both, removal of osteochondral fragments and other separated cartilage and bone, debridement of lesions to viable tissue margins with the capacity to heal and synovial lavage (Mcllwraith *et al.,* 2014). There have been two basic techniques developed for arthroscopic surgery. But only a triangulation technique which involves bringing one or more operating instruments through separate portals and into the visual field of the arthroscope where the tips of the instrument and the arthroscope forming the apex of a triangle has been used to handle all of the various surgical requirements in equine joints (Mcllwraith *et al.,* 2014).

The treatment of lesions within the joint depends on the type of lesion. Bone fragments may require separation from the parent bone with an osteotome or dissection off their soft tissue attachments with a sharp instrument such as a meniscal knife or an O'Connor punch. It is wise never to free the fragment completely before removal in order to avoid it floating free into the joint. Ferris Smith rongeurs are ideal for removing fragments and several cup sizes are necessary ranging from 2 × 10 mm to 6 × 12 mm. When removing large fragments through the joint capsule, widening of the incision by sharp dissection may be necessary as the fragment is

withdrawn. The debridement of soft tissue lesions such as infected synovial villi or torn ligament tissue can effectively be performed using a motorized synovial resector or a scissor-action punch instrument.

Several studies were conducted previously on different joint locations for different lesions. For instance arthroscopic removal of apical sesamoid fracture fragments (Schnabel *et al.,* 2007), axial osteochondral fragments of the proximal phalanx (Simon *et al.,* 2004) osteochondral fragments of the elbow (Bobkiewicz & Hodgson, 2011), dorsoproximal chip fractures of the proximal phalanx (Elce & Richardson, 2002), arthroscopic debridement of distal phalanx extensor process fragmentation (Crowe *et al.,* 2010), and treatment of intra-articular insertional injuries of the suspensory ligament branches (Minshall & Wright, 2006).

2.1.1 Prognosis

Arthroscopic surgery was effective in removing all the osteochondral fragments as well as treating other lesions. There were no cases of intra-articular infection and few other complications. The overall functional ability and cosmetic appearance of the limbs were excellent (McIlwraith *et al*., 2014). Post surgical follow-up information was obtained for 445 racehorses and revealed that 303 (68.1 %) raced at level equal to or better than the pre-injury level and only 23 (5.2 %) were retired without returning to training (McIlwraith *et al.*, 2014). Based on the study done by Southwood & McIlwraith (2000), twelve of the racehorses (50 %) returned to

racing and started in at least 2 races after arthroscopic removal of fracture fragments involving a portion of the base of the proximal sesamoid bone.

2.2 Arthroscopically guided internal lag screw fixation

2.2.1 Principles

Screw fixation is one of the examples for internal fracture fixation. The major advantages of internal fixation are that it provides rigid stabilization of the fracture and immediate, functional use of the limb (Auer *et al.,* 1993). The disadvantages of internal fixation are the associated costs of the general anaethesia, implants, and equipment required to apply the internal fixation devices (Trostle & Markel, 1996). Aside from economic issues, internal fixation requires experienced personnel with developed proficiency and firsthand knowledge of the implants, equipment used and orthopedics fixation. The contact between implant and bone is kept stable using screws which function like locked threaded bolts but the biological aspects of damage to the blood supply, necrosis and temporary porosity explain the importance of avoiding extensive contact of the implant with bone (Perren, 2002).

There are two basic types of screws (cortical and cancellous), which are then usually classified by their diameter (Auer *et al.,* 1993). Initially, 4.5 mm cortex screws were used but later 5.5 mm cortex screws were advocated because of their superior strength (Rahim *et al.,* 2000). Lag fashion screw fixation is where the screw is inserted in a distal to proximal direction and according to Busschers *et al*. (2008), most horses had a single 4.5 mm screw inserted.

Several studies of an arthroscopically guided internal lag screw fixation were reviewed which include repair of carpal chip fractures (Wright & Smith, 2011), fracture of intercondylar eminence of the tibia (Walmsley, 1997), fracture of greater tubercle of the humerus (Madron *et al.,* 2013), sagittal fractures of the proximal phalanx and medial and lateral third metacarpal/metatarsal condylar fracture (Payne & Compston, 2012), mid-body sesamoid bone fracture (Hubert *et al.,* 2001), and third carpal slab fractures (Mcllwraith, 2015).

2.2.2 Prognosis

According to Bertone (2015), for mid-body fractures repaired with lag screws, 75 % (9 of 12) of Standardbreds were able to race after the surgery. Additionally, 63 % (5 of 8) Thoroughbreds were able to race, and one horse performed as a 3-days event horse after the surgery. Besides, it was found that seven of 16 horses (44%) with screw fixation raced after the surgery (Busschers et al., 2008) and a series of 40 cases treated by lag screw fixation show a 72 % success rate in which the horses returning to complete soundness and previous work level (Colles, 2011). Martin *et al*. (1991) reported that the prognosis following the repair of mid-body sesamoid fractures is good for athletic use, although the level of performance could be reduced. Based on Busschers *et al*. (2008), mid-body fractures typically heal poorly if treated conservatively.

Schneider and Jackman (2015) stated in their report that in a retrospective study, 9 of 11 horses with non-displaced lateral condylar fractures treated with surgical repair were able to race post-operative. Besides, it was also found in the study done by Wright and Smith (2011), twenty three horses (82 %) returned to racing 3 – 22 months; mean 10 months after the surgery. Based on a retrospective study done by (Mizuno, 1996) , stated that of 155 horses with carpal fractures that had arthroscopically guided surgery, 123 (79 %) returned to racing after surgery.

2.2.3 Duration to the first start race post-operatively.

Nine months after surgery, 83.9 % of Grade 1 horses and 64.5 % of Grade 2 horses (Figure 1), which had arthroscopic surgery had returned to race representing 68.4 % of all horses in the study (Mizuno, 1996).

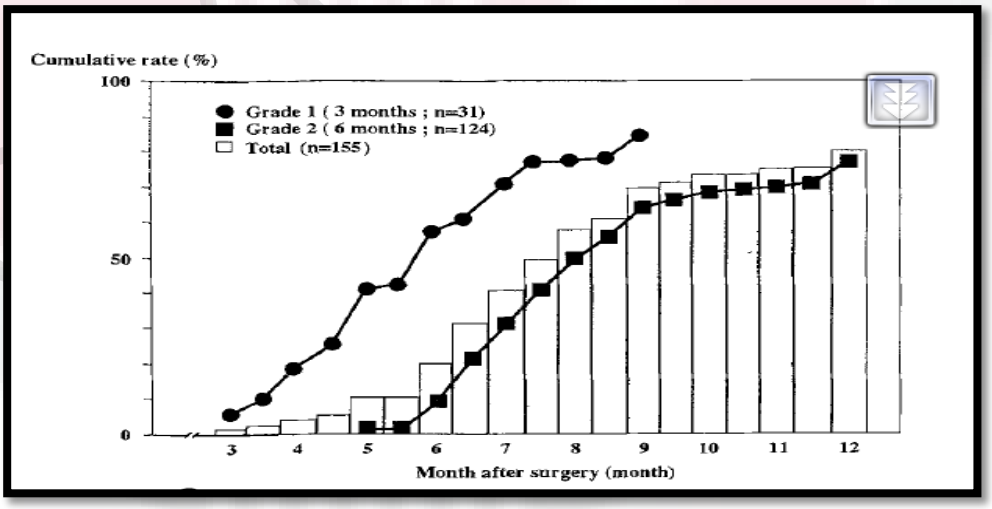

Figure 1: Cumulative rate of horses returned to racing after surgery from year 1993 to 1994 [n=155].

(Mizuno, 1996)

2.3 Arthrotomy

2.3.1 Principle

Arthrotomy is indicated in order to treat a chronic septis arthritis or extensive fractures. In a chronic septic arthritis where an open drainage is necessary, 3 to 6 cm arthrotomy is recommended to allow fibrin and fluid to drain from the joint space. Somehow, the post-operative management need a very commitment as the bandage need to be changed daily and the skin around the open drainage should be always with povidone-iodine soap and rinsed with alcohol soaked gauze. Antibiotic intra-articularly was administered every day for the first few days. (Schneider, 1998).

2.4 Arthroscopy versus Arthrotomy

The advantages of arthroscopy over arthrotomy are numerous which include less soft tissue trauma, the convalescent period is considerably shorter and functional and cosmetic recovery is better (Weeren, 2015). Direct comparison of arthroscopy with arthrotomy showed that hospitalization time after arthroscopy was almost one fifth of that after arthrotomy.

3.0 MATERIALS & METHODOLOGY

3.1 Inclusion criteria

Hospital surgical records and lifetime race records were examined for Thoroughbred horses that underwent joint surgery for the treatments of several locomotion disturbance and lameness upon physical examination at Perak Turf Club, Ipoh between year 2008 and 2015. To be included, horses operated in year 2014 had to be of racing age during year 2015. Performance of the involved horses was reviewed through Malayan Racing Association (MRA) website.

Retrieved data from the surgical records were as follows: age, affected limb in association to specific joint location and lesions in association to the type of surgical treatment. From MRA website, the data collected were frequency of races in the lifetime till date, number of races after the surgical procedure, and duration after surgery for the first start.

3.2 Statistical analysis

Frequency distributions were calculated for all categorical variables. The distribution of age, arthroscopic surgery location, arthroscopic guided internal lag screw fixation and arthrotomy were compared with the prognosis of each case (duration after the surgery for the first start of the race) using the Chi-square test. A significance level of 0.05 was used.

4.0 RESULTS

4.1 Joint surgeries occurrences

From a total of 858 surgery cases that have been performed in Perak Turf Club Veterinary Hospital (VH), 218 were related to the joint area (Figure 2). These include arthroscopic surgery, arthroscopic guided internal lag screw fixation, and arthrotomy. The occurrence of joint surgery over 8 years was 25.41 % and the highest occurrence was in the year 2015; 32.61 % (15/46 cases) and the least was in the year 2012; 19.15 % (18/94 cases) recorded (Appendix I, Table 1). The average joint surgery that has been performed within 8 years was 27 cases.

Throughout the period of 8 years, arthroscopic surgery was 21.1 % (181/858), arthroscopic guided internal lag screw fixation; 2.21 % (19/858), and arthrotomy; 2.1 % (18/858) as shown in Figure 3. Other surgeries include respiratory system surgery, castration, colic surgery and others, which comprised 75 % (Appendix I, Table 2).

As shown in Figure 4, frequency of each surgical approach showed that arthroscopic surgery was the most surgery had been done; 181 cases (83.0 %), followed by arthroscopic guided internal lag screw fixation; 19 cases (9.0 %) and the least was arthrotomy; 18 cases; 8.0 % (Appendix I, Table 2).

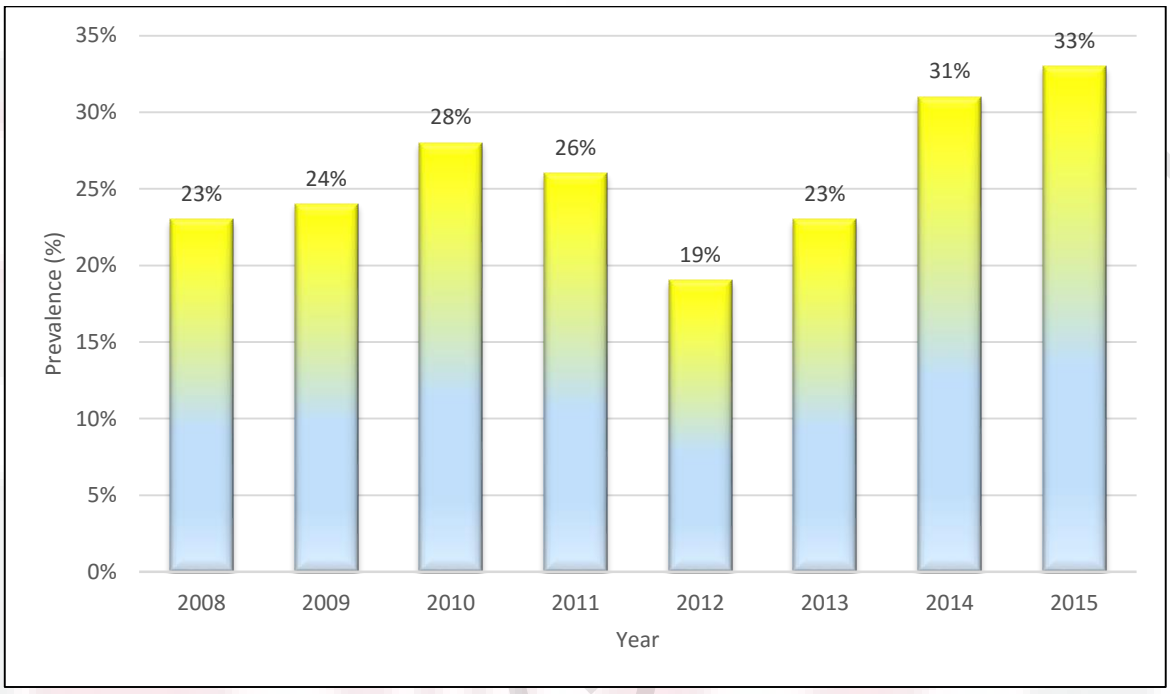

Figure 2: Occurrence distribution of joint surgery performed in PRTC from year 2008 to 2015.

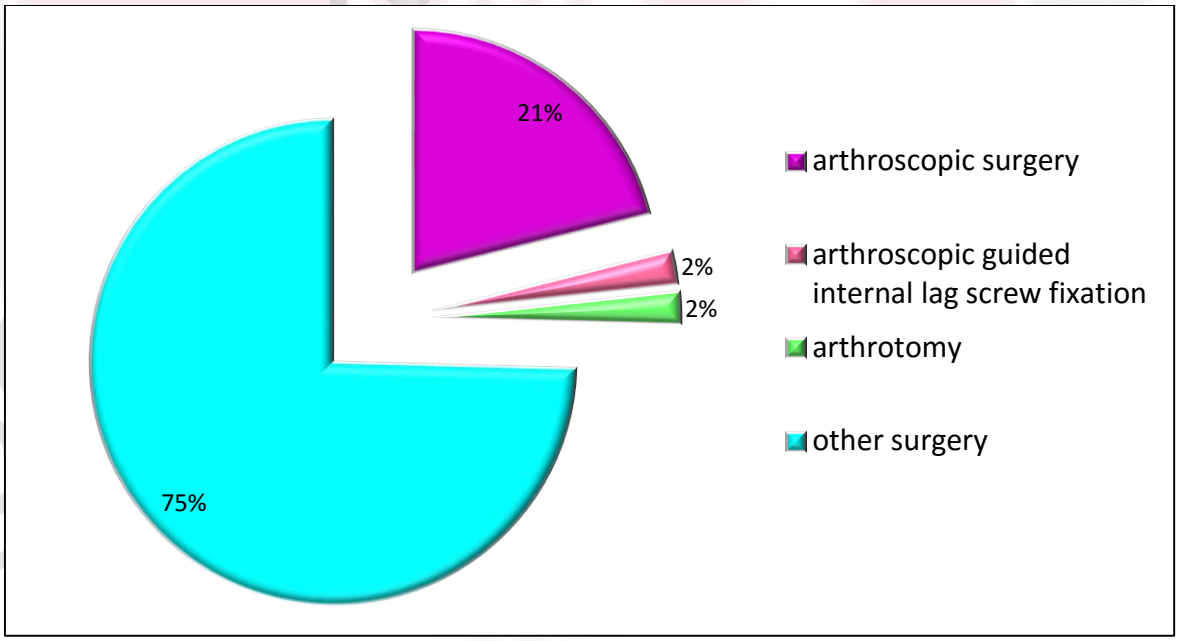

Figure 3: Percentage distribution of surgical procedures over 8 years from year 2008 to 2015.

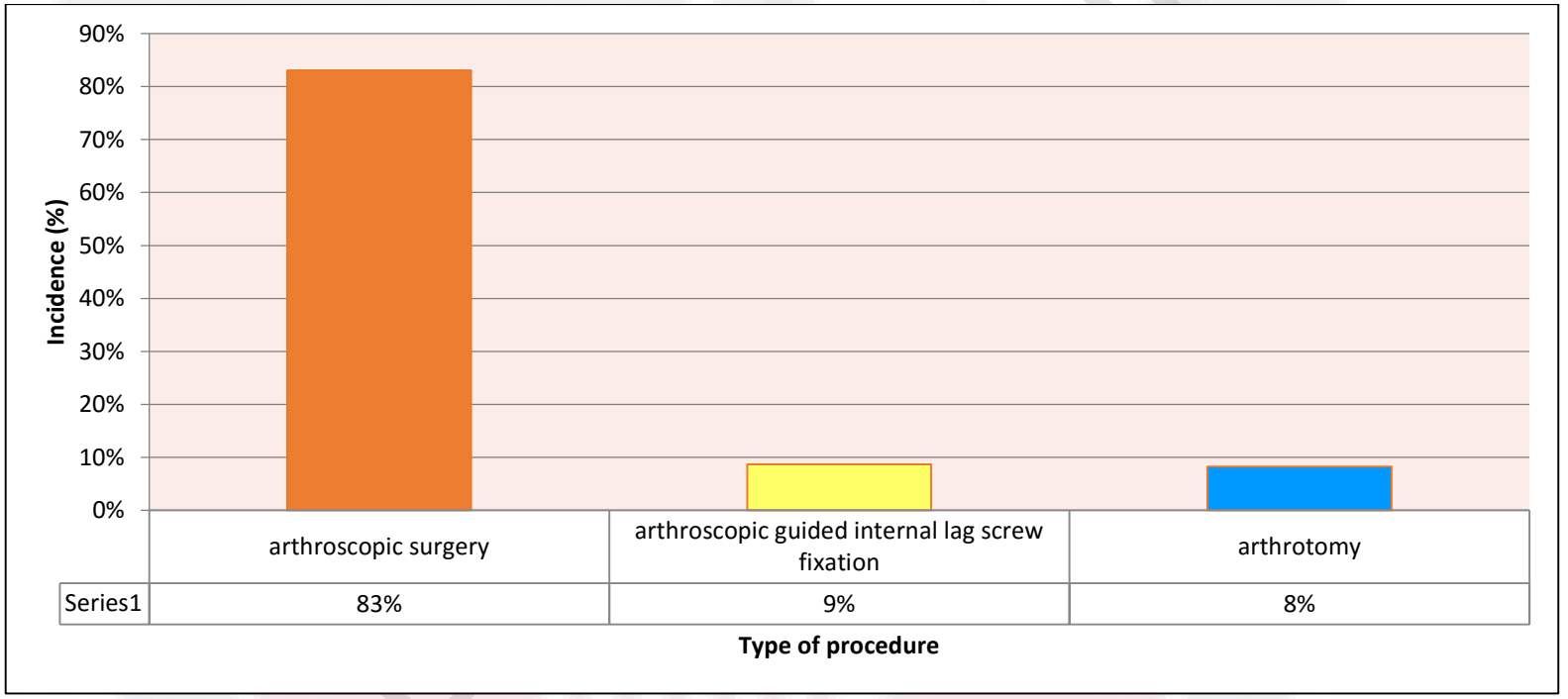

Figure 4: Frequency of different joint surgical procedures over 8 years from year 2008 to 2015.

Based on Figure 5, the lowest frequency of arthroscopic surgery was in the year 2010; 69.57 % (32/46), and the highest was in the year 2012; 94.44 % (17/18). For arthroscopic guided internal lag screw fixation, there was no surgery performed in the year 2011 and the highest incidence was in the year 2015 (20 %; 3/15). No case was reported for arthrotomy for year 2011 and 2015. The highest frequency was 17.39 % (8/46) in year 2010 (Appendix I, Table 3 and 4).

From 181 cases with arthroscopic surgery, the highest joint location was at the right carpal; 62 cases (34.3 %), followed by left carpal; 54 cases (29.8 %), both carpal; 31 cases (17.1 %), right forelimb fetlock; 17 cases (9.4 %), left forelimb fetlock; 11 cases (6.1 %), both forelimb fetlock; 4 cases (2.2 %) and the least were at the stifle and right hind limb fetlock joint; 1 case each (0.6 %) as shown in Figure 6 (see appendix II, Table 5). In comparison, between joints, the study showed that cumulative frequency of the carpal joint surgery was the highest with 147 cases (81.0 %), followed by fetlock joint (33 cases; 18.0 %) and only 1 % for stifle joint (Figure 7).

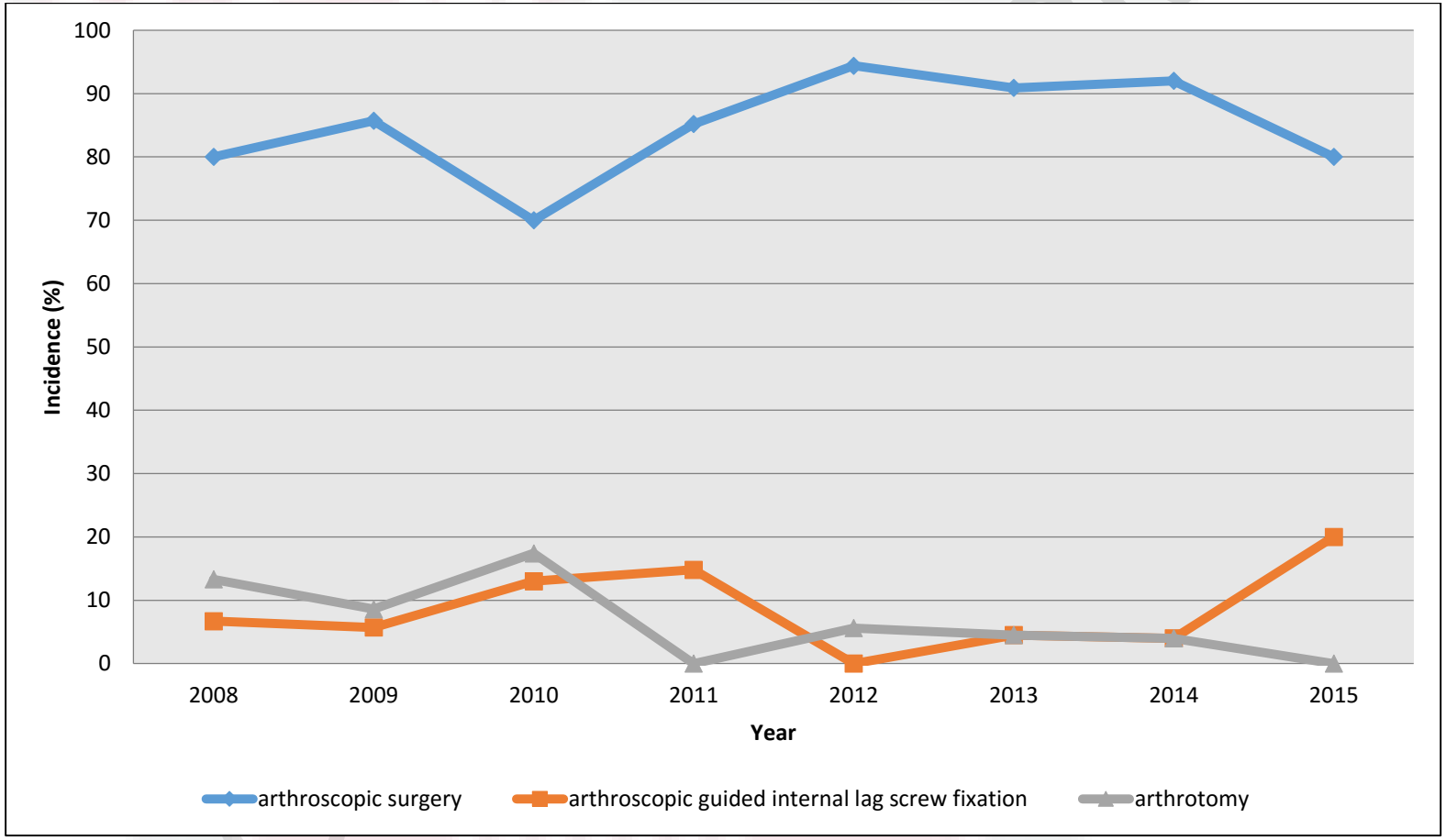

Figure 5: Frequency distribution of different joint surgical procedures from year 2008 to 2015.

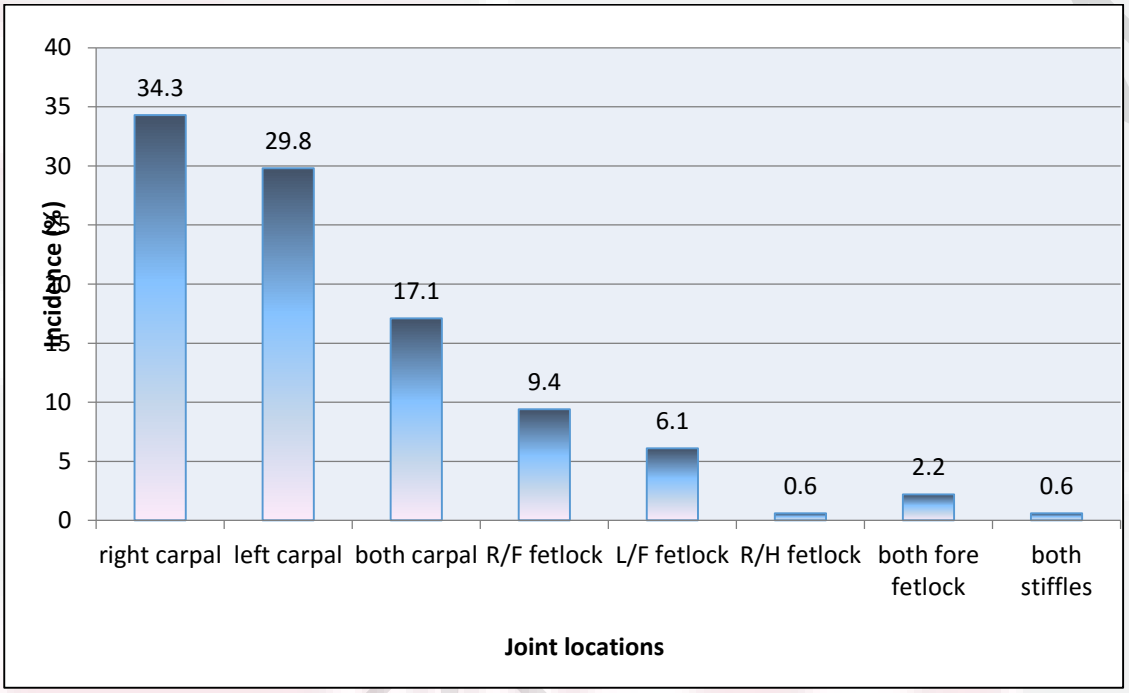

Figure 6: Frequency of arthroscopic surgery between different joint locations.

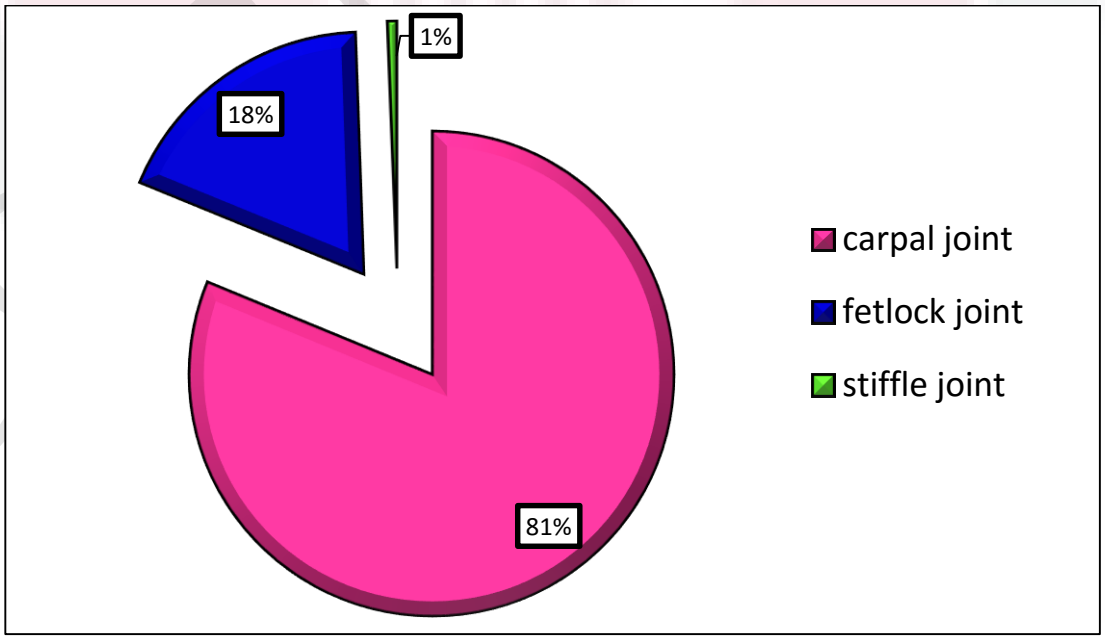

Figure 7: Percentage of arthroscopic surgery between different joints (n=181).

For arthroscopic guided internal lag screw fixation, of 19 cases, third carpal slab fracture was the most injury that required this surgical treatment with a record of 11 cases (58 %), followed by left forelimb medial sesamoid fracture (3 cases; 16 %), right forelimb medial sesamoid fracture (2 cases; 11 %), and the least were third carpal sagittal fracture, lateral condylar and left forelimb distal cannon fracture with each cases reported only once throughout the study (5 %) as shown in Figure 8 (Appendix II, Table 6).

Lastly, for arthrotomy, 18 cases were recorded and the highest lesion was found at the left forelimb fetlock joint (7 cases; 38.9 %), followed by equal case for both right forelimb and right hind limb fetlock joint (4 cases; 22.2 % respectively), then right carpal joint with 2 cases (11.1 %), and the least was left carpal joint with only one case (5.6 %), shown in Figure 9 (Appendix II, Table 7).

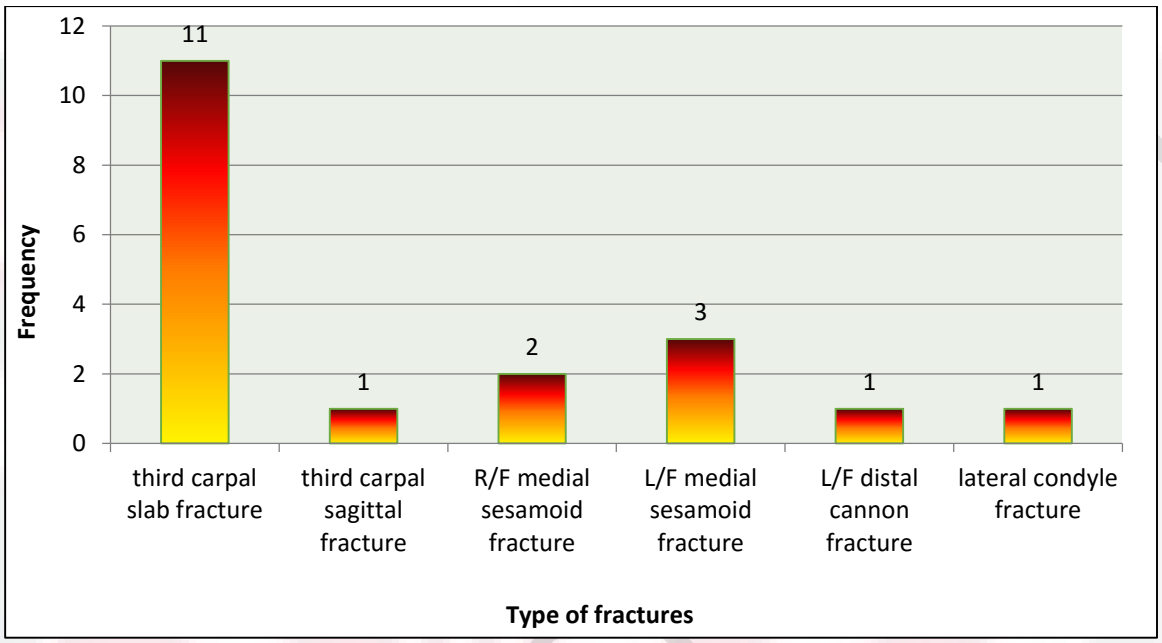

Figure 8: Frequency of lesions subjected to arthroscopic internal lag screw fixation from year 2008 to 2015.

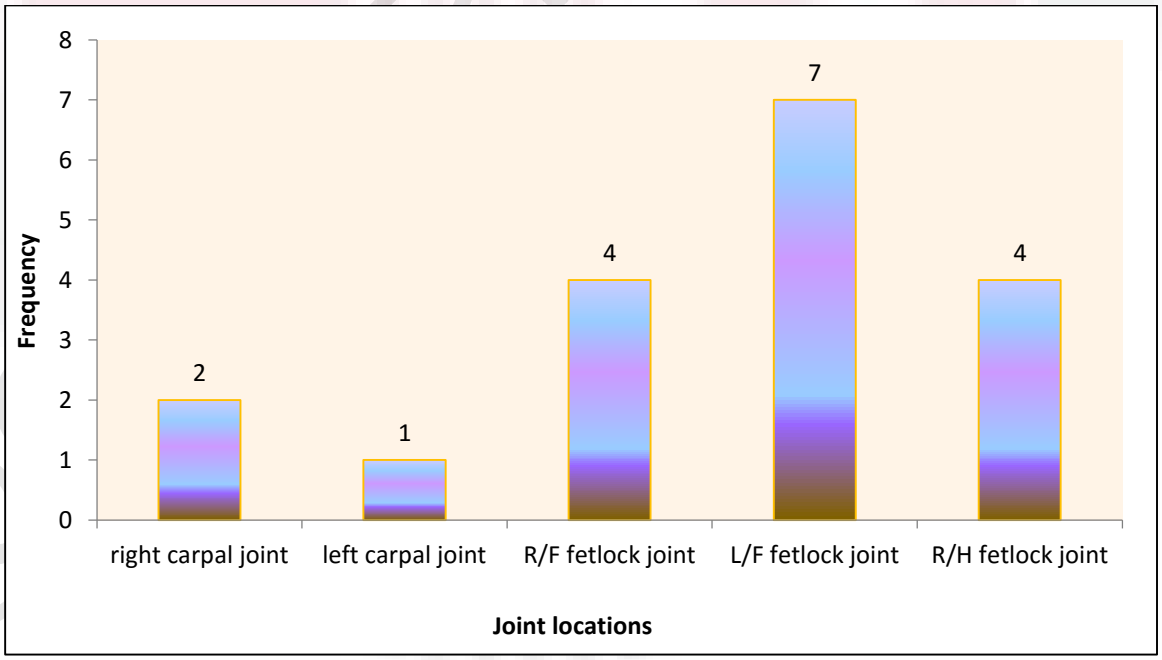

Figure 9: Frequency distribution of joints subjected to arthrotomy.

4.2 Frequency distribution

4.2.2 Distribution of age

The distribution of age for the horses involved in this study ranged from 1 to 9 years old (median = 5 years). Four and five years old horses contributed to the highest percentage (60.1%) among the 218 horses in this study. The age group was then classified into three subgroups, juvenile (1 to 3 years old), mature (4 to 6 years old), and adults (7 to 9 years old). As shown in Figure 10, the frequency distribution in juvenile was 30 horses (13.8 %), 169 mature horses (77.5 %) and 19 adult horses (8.7 %). From 30 juvenile horses, 26 (14.4 %) horses undergone arthroscopic surgery, 3 (15.8 %) horses had arthroscopic guided lag screw fixation, and 1 (5.6%) had arthrotomy (Appendix III, Table 7 & 8).

In general, majority of horses in this study was at the age of 5 years old; 31.65 % (69/218), followed by 4 years old; 28.9 % (63/218), and the least was one horse at the age of one years old; 0.46 %, as shown in Figure 11 (Appendix III, Table 9). In the descriptive test, it was revealed that the mean and median age for both arthroscopic surgery (range 1 to 9 years old) and arthroscopic guided internal lag screw fixation (range 3 to 8 years old) were the same; (mean= 4.74 years old, median= 5 years old), whereas the values in arthrotomy (range 3 to 8 years old) was slightly higher (mean= 5.56, median= 6 years old).

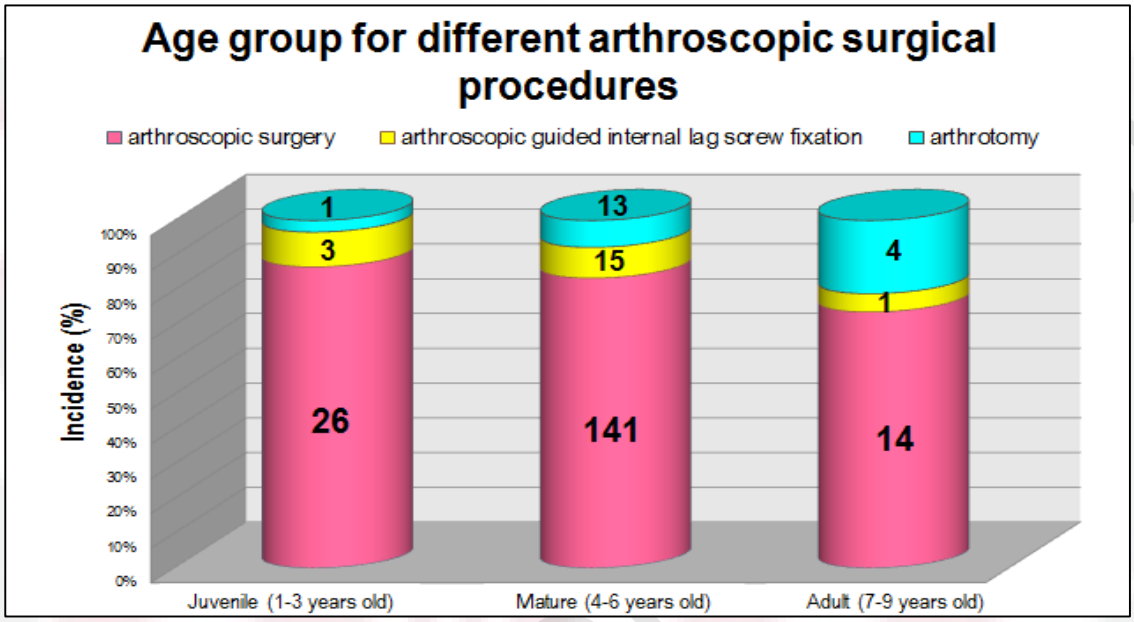

Figure 10: Number of cases for different arthroscopic surgical procedures within each age group.

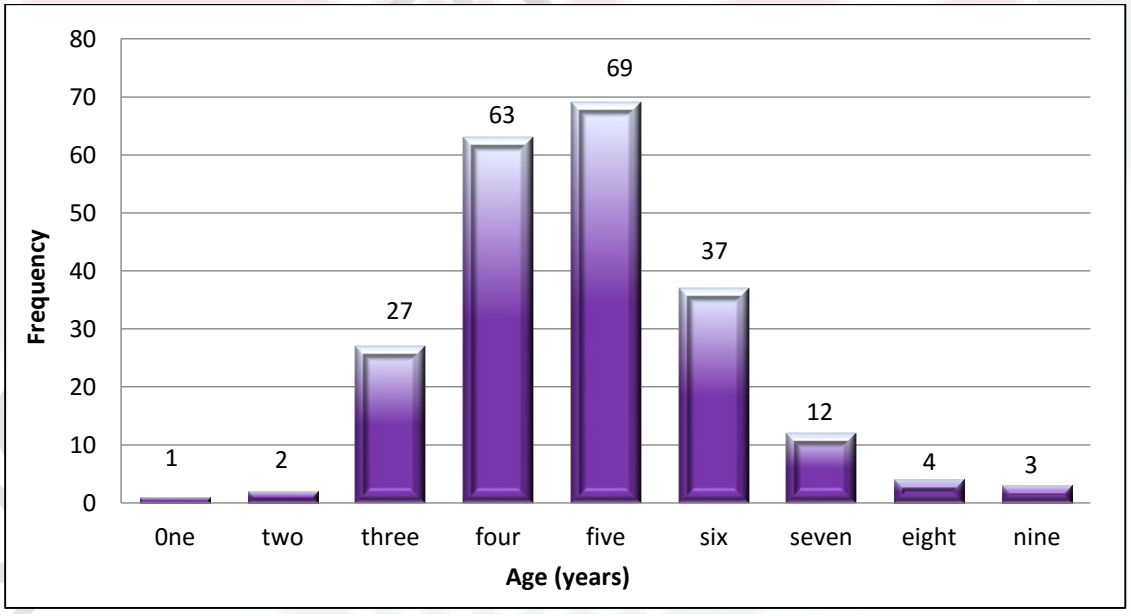

Figure 11: Frequency of cases within age distribution (n=218).

4.2.2 Distribution of duration to first start after surgery

From a total of 218 horses in the study, 135 (61.9 %) made at least one parimutual start after the surgery. About 6 horses (2.8 %) were still under the post-operative care (rest). Unfortunately, there was a limitation to have the accurate data. There were 77 horses (35.3 %) did not race or deregistered in which the life-time race records could not be obtained, and were therefore considered as failures, even though the lack of a race record may have been caused by some extraneous influence. Among 135 horses that had their start, 94 horses comprised 70 % (25, 21, 23, and 25 horses in 210, 240 and 270 and 300 days respectively). Out of 94 horses, 82 (45 %) horses had arthroscopic surgery, 5 (26.3 %) horses had arthroscopic guided lag screw fixation and 7 (33.9 %) horses had arthrotomy (Appendix III, Table 10). Among the three surgical procedures, there were 6 horses (2.75 %) had their first start within the shortest period post-operatively, in 120 days. Only 0.92 % (2/218) of arthroscopic guided lag screw fixation case had the longest period to the first start post-operatively; 510 days (Figure 12). The mean for number of days to the first start post-operatively was different within each surgical procedure.

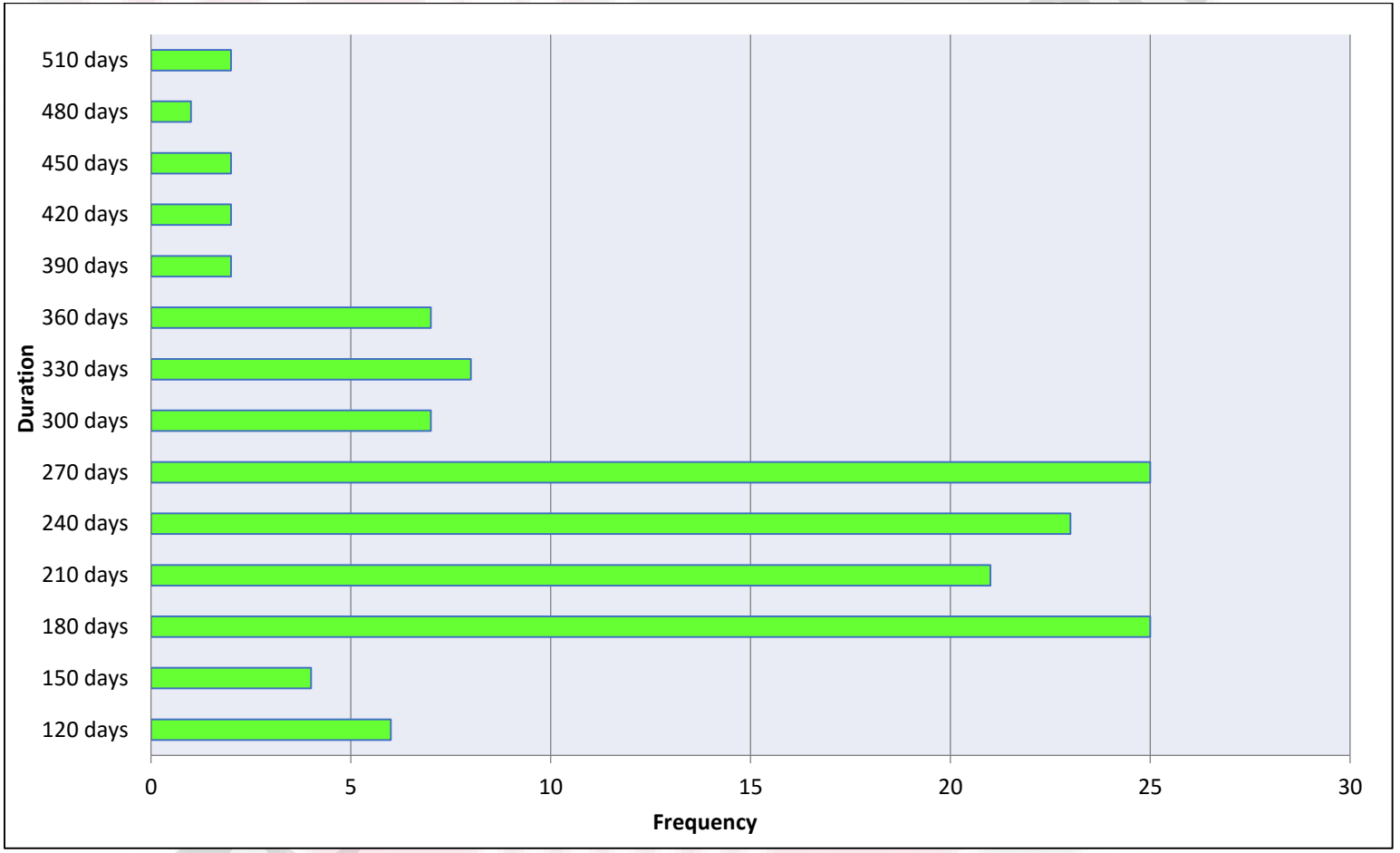

Figure 12: Frequency of cases with the duration to the first start post-operative.

4.2.3 Distribution of number of races (starts) after the surgery

The frequency of starts after surgery is the indicator of prognosis. Horses raced after surgery made an average of 6 starts (median = 3 starts), and the most recorded race after surgery was 72 races. There were 83 horses (38.1 %) did not race after the surgery due to several factors. From a total of 83 horses, those with arthroscopic guided internal lag screw fixation had the highest incidence (60 %; 12/19) followed by arthrotomy (44 %; 8/18) and the least arthroscopic surgery (34.8 %; 63/181). Refer to Appendix III, Table 11. The mean number of races after the surgery is different between each surgical procedure. Maximum number of race was 72 for arthroscopic surgery and 22 for both the other two procedures. Frequency of races after the surgery has been grouped into 6 subgroups (1 = 1 to 10 races, 2 = 11 to 20 races, 3 = 21 to 30 races, 4 = 31 to 40 races, 5 = 51 to 60 races, 6 = 71 to 80 races), shown in Figure 13. There was 41.7 % (91/218) with median of 6 races (range 1 to 10). Only 3 horses (1.5%) had successfully raced more than 30 races and all of them were subjected to arthroscopic surgery (Appendix III, Table 12). From a total of 91 horses in range 1 to 10 races, there were 77/181 horses (42.5 %) for arthroscopic surgery, 6/19 horses (31.6 %) for arthroscopic guided internal lag screw fixation, and 8/18 horses (44.4 %) for arthrotomy.

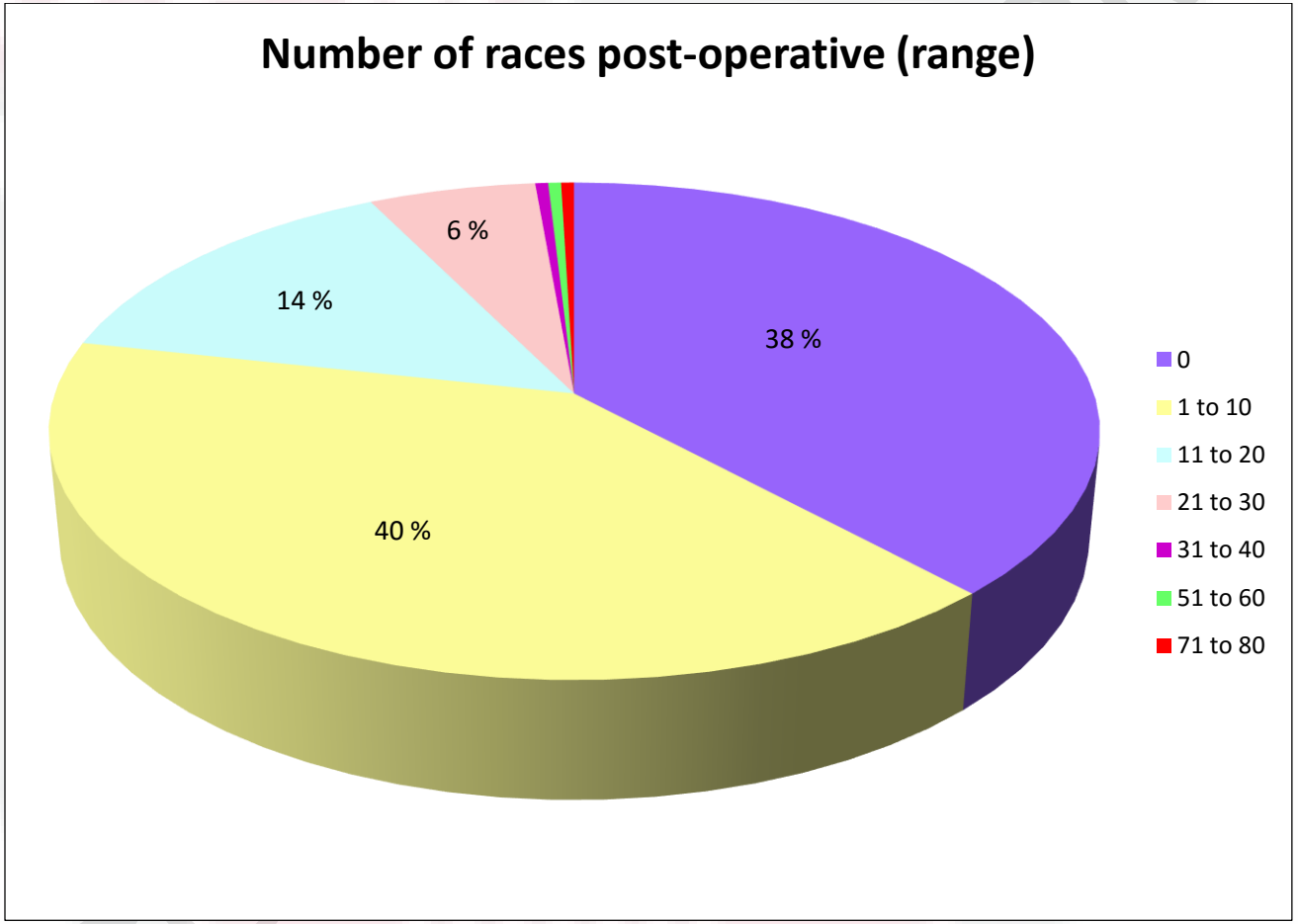

Figure 13: Percentage of cases in association to the number of races post-operative

4.2.4 Distribution of life span races

From a total of 218 horses, the life span races in average for these horses were about 15 races (median = 12 races). Forty-nine horses (22.5 %) were considered failed as there were no race records that could be retrieved from the resource. The highest frequency of race between the three different surgical procedures was 5 races (4.6 %) in which (8/10 in arthroscopic surgery and 1/10 each for the other two procedures). Descriptive test results were for arthroscopic surgery (mean = 16; median = 13; maximum = 75 races), arthroscopic guided internal lag screw fixation (mean = 8; median = 4; maximum = 26 races) and arthrotomy (mean = 13; median = 13; maximum = 30 races).

The number of races in the lifespan was then subdivided into several subgroups. The highest frequency ranged from 11 to 20 races; 54 horses (24.8 %) with a median of 16 races, followed by a range from 1 to 10 races; 51 horses (23.4 %) had a median of 6 races, and the least frequency were 61 and 75 (0.5 % respectively) as shown in Figure 14 (Appendix III, Table 14). From 54 horses (range from 11 to 20 races) comprised of 90.7 % (49/181), 1.9 % (1/19), and 7.4 % (4/18) were the detail distribution between different surgical procedures in this study (Appendix III, Table 13).

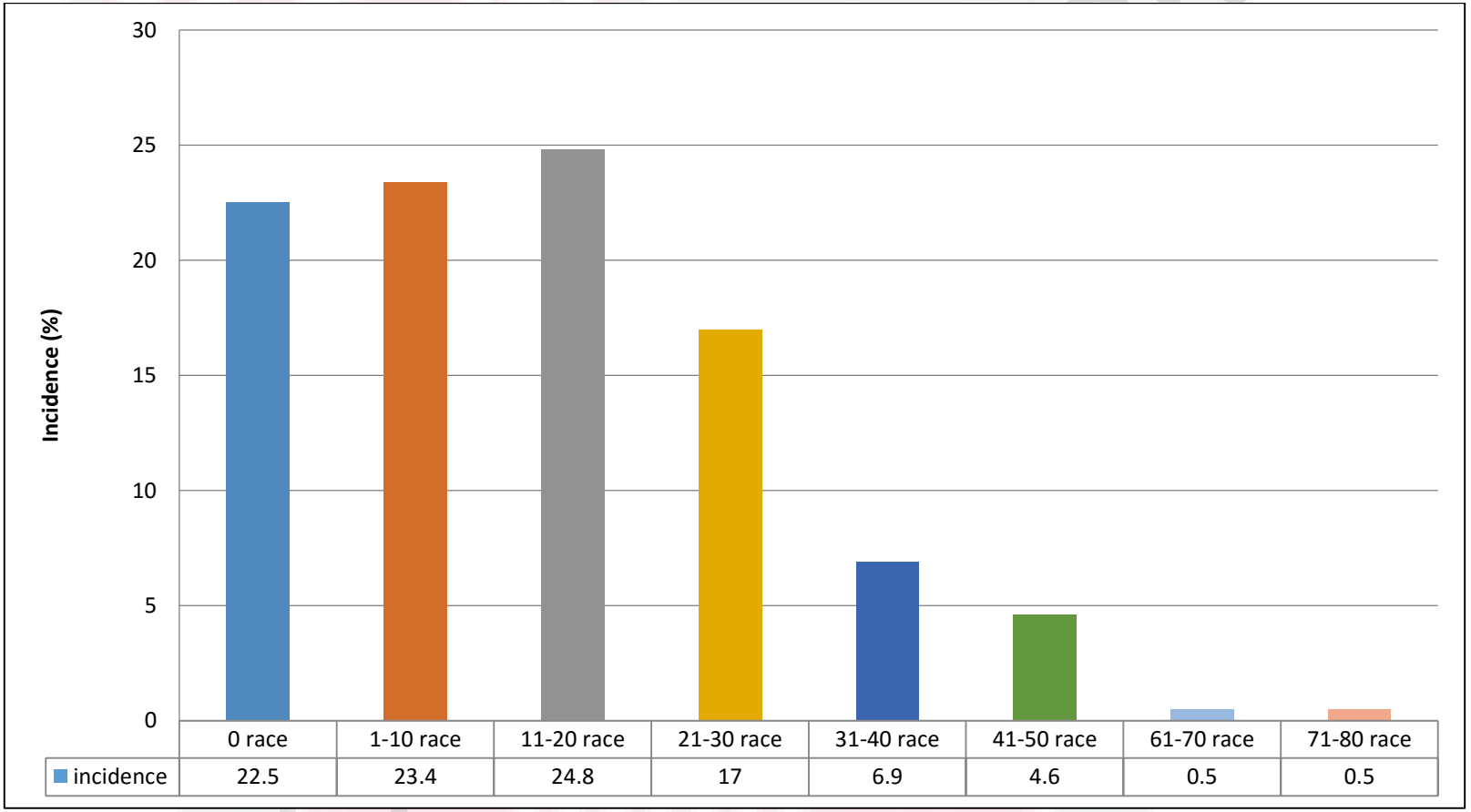

Figure 14: Frequency of number of lifespan races to year 2015.

4.2.5 Distribution of number of races before surgery

From a total of 218 horses in this study, 153 horses (70.2 %) started their career of racing before the surgery. Sixty-five horses were recorded with no races prior to surgery. The highest frequency rate of races frequency before surgery was 4 to 5 races (Appendix III, Table 16). The values for arthroscopic surgery were mean = 9, median = 5, maximum = 43 races; arthroscopic guided internal lag screw fixation with mean = 4, median = 1, and maximum = 16 races and for arthrotomy with the mean = 9, median = 6, maximum = 28 races.

Cumulatively, over 8 years, most of the horses subjected to surgery has already started their career. 83/218 (38.1 %) of horses were at least had one race before the surgery (range 1 – 10 races), followed by 18.8 % (41/218) horses in the range (11 – 20 races) and the least with 1.4 % (3/218) had races before surgery in the range (41 – 50 races), shown in Figure 15.

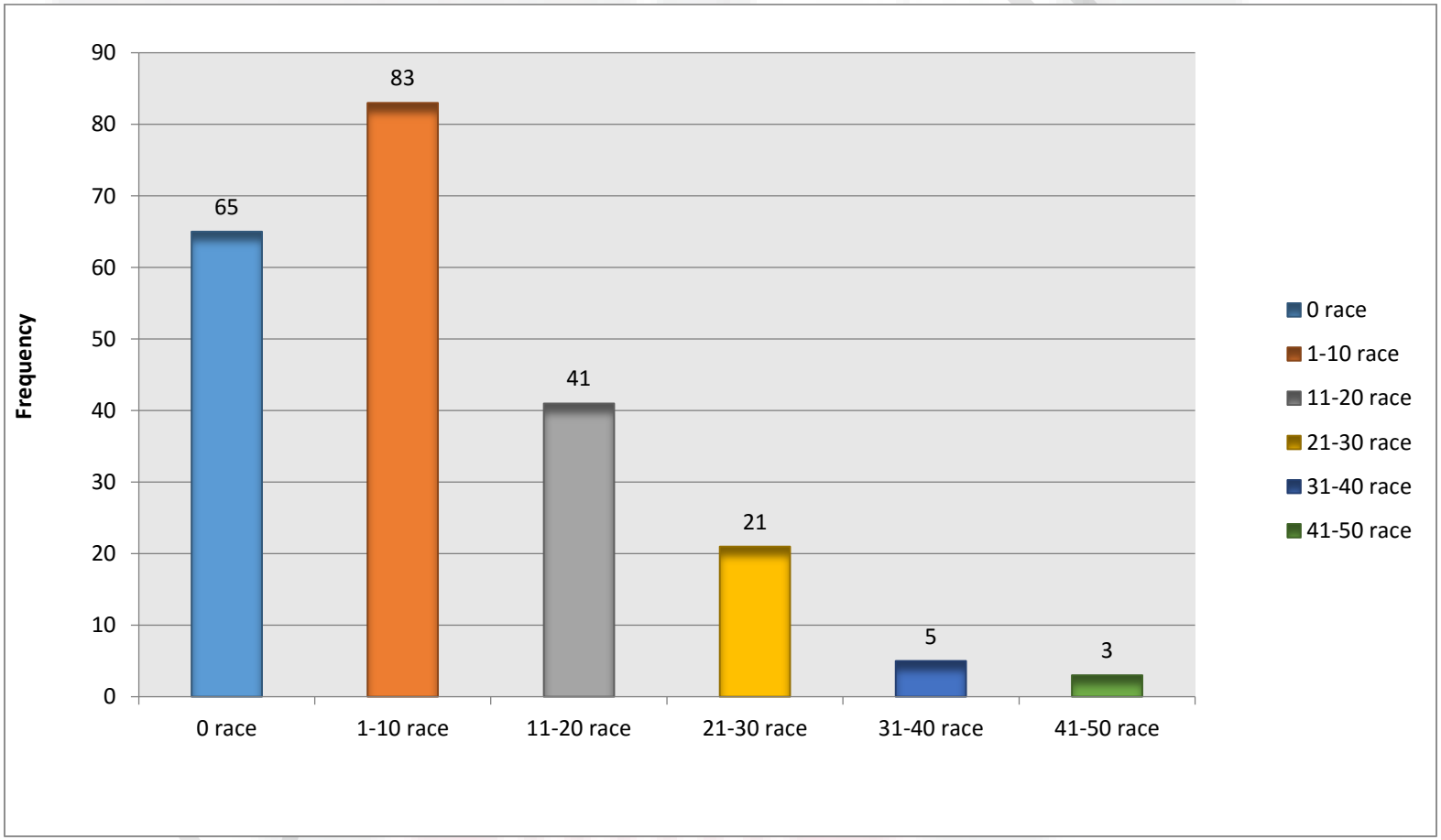

Figure 15: Frequency number of cases for races before surgery from year 2008 to 2015.

4.3 Statistical analysis

There was no statistically significant relationship in the distribution of age between the surgical approaches (df= 16, p= 0.243). Somehow, for duration to the first start of race and frequency of lifespan races for these horses were shown statistically significant relationship between the age distribution (df= 40, p=0.010 and df= 344, p= 0.000 respectively). The result also showed that the number (frequency) of races after surgery for each horse in this study was dependently related to the age distribution (df= 12, p=0.045).

The test results a statistically significant relationship in the duration to the first start race in these horse between the three different surgical approaches (df= 10, p= 0.000). Both the number of races after surgery and the frequency of lifespan races were independently related to the surgical approaches in this study (df = 60, p= 0.999 and df=86, p= 0.991 respectively).

For arthroscopic surgery, there was no significant relationship between different joint locations and the duration to the first start race within the 181 cases (df= 28, p= 0.923). Frequency of lifespan races and number of starts after surgery also were independently related to the different joint locations (df= 86, p= 1.000 and df= 12, p=0.276). However, the results revealed that age group was statistically significant related to the different joint locations (df= 4, p= 0.004). All variables (duration to the first start race; p= 0. 006, number of starts after surgery;

p= 0.045 and frequency of lifespan races; p= 0.000) had association with different age groups.

In arthroscopic guided internal lag screw fixation, all variables of interest (age; p= 0.949, duration to the first start race; p= 0.275, number of starts after surgery; p= 0.215, and frequency of lifespan races; p= 0.339) were independently related to the factor (type of fractures) involved in this study. Besides, there were also no associations between age groups to all variables of interest.

From a total of 18 horses with arthrotomy, there was a significant relationship in the distribution of number of races after surgery and between the different joint locations; p= 0.018. However, other variables (duration to the first start race; p= 0.517, age groups' p= 0.151, and frequency of lifespan races; p= 0.372) had no significant relationship to the different joint locations of the horses that had subjected to arthrotomy. There were also no relationships between age and all the variables of interest.

4.3.2 Mann- Whitney test

There was a statistically significant difference in the duration to the first start race after the surgery between the age groups which are the juvenile; 1 to 3 years old and mature; 4 to 6 years old (p= 0.001). There were also differences in distribution of the frequency of lifespan races and number of races after surgery to the age group with p= 0.021 and p=0.001 respectively. For all of the three

variables, the mean rank of the mature age group exceeds the mean rank of the juvenile age group.

For arthroscopic surgery, of grouped age, the distribution were significantly different between juvenile (1 to 3 years old) and mature (4 to 6 years old) for duration to first race after surgery; p= 0.000 (mean rank; juvenile = 120.10, mature = 77.34) and also number of races after surgery; p= 0.021 (mean rank; juvenile = 102.90, mature = 80.51). There were also significantly different between juvenile and adult for frequency of lifespan races; p=0.001 (mean rank; juvenile = 15.88, adult = 29.07) and duration to first start; p= 0.010 (mean rank; juvenile = 23.90, adult = 14.07). Lastly, adult distribution for both lifespan (p= 0.000), mean rank; (121.71/73.66) and joint locations (p= 0.015), mean rank; (97.07/76.11) were significantly difference to the mature age group. There was a significant difference in the distribution of both durations to first start race and number of races after surgery between the carpal and fetlock joint (p= 0.001; mean rank; carpal = 96.29, fetlock= 64.71 and p= 0.001, mean rank; carpal= 96.07, fetlock= 65.70).

5.0 DISCUSSION

From the findings, it is suggested that carpal joint is the most affected joint with the right limb with the evidence of having the highest frequency. This is supported by a prospective cohort study done by Reed *et al.* (2010), which stated that unilateral carpal injuries were most commonly seen in the right limb than in the left limb. Most of the carpal joint injuries involved abnormalities of the subchondral bone or articular margin and usually carpal joint would appear more vulnerable to chronic subchondral bone pathology (Reed *et al.,* 2010)

From this study, it showed that the highest risk for the horse to be subjected to joint surgery is 5 years old. The trend in this study was that most of the Thoroughbred horses that undergone carpal joint surgeries were within the age of three to five years old. By considering that racehorses typically commence intensive training and start the racing career as in 3 years old. We can also see the evidence that the injury at the fetlock joint was mostly commence by the horse at the age of more than 5 years old up to 9 years. This is explained by Reed *et al.* (2010) that in the latter age, the accumulated microdamage from a higher number of loading cycles in the older horses.

This study also revealed that carpal joints were more predisposed to the injuries that subjected to the surgical treatment as 60 to 65% of the body weight bear at the both fore limbs and subjected to a greater state of concussion with each steps especially during strenuous activity such as racing. Less injury recorded at

the fetlock joint for when a racehorse runs at top speed, there is one point in every stride where its entire weight descends upon one front leg where most of the concussion is absorbed and will then be dissipated by the fetlock joint. Due to the repetitive trauma at training and racing, it leads to cortical damage of the articular cartilage because of the non-compliant subchondral bone, hence results in sclerotic bone which undergone ischemic necrosis and eventually established a chip fractures.

In the arthroscopic guided internal lag screw fixation, the highest frequency of the horse subjected to the surgery was at the age of 5 years old and above suggestive that the horse being pushed to its limits in a competitive environment. This is because, majority of the training exercise occurring at the lower speeds, and perhaps it should be no surprise to see such fractures following the sudden change in the loading environment under racing condition. This is seen an older horses as suggested by Nunamaker *et al.* (1990) that the reduction in adaptive bone response with age may help to elaborate the finding that over half of the fractures seen in older horses occur on the racecourse, as the high impact forces of racing may be more likely to cause damage in the older horses. As in comparison, Riggs (2002) stated in his writing that bone especially in the young horses, respond to physical exercise by adapting its strength and architecture according to the loads it must tolerate. The highest frequency of median sesamoid bone involvement in this approach suggests that during intense activity, the suspensory and distal sesamoidean ligament exerts tensile forces on the proximal

sesamoid bones. At high speed or end of a race, when hyperextension of the fetlock joint is greatest due to fatigue, maximal loading can produce tensile forces on the sesamoid bone in excess to their strength resulting in the fracture.

To indicate the successfulness of the joint surgical approach, duration to the first race post-operative is used as a parameter. It took at least 6 months for the horses to come back into their racing career of which could be due to recovery period and also re-training regime. This is also reported in other study by (Mcllraith, Yovich, & Martin, 1987) in which the mean convalescent time to race was 9.5 month. Within the duration, in the post-operative course, Walmsley (1997) stated that the horse should be box rested for 6 weeks, then hand walked for a further 6 weeks before being turned out. It was then supported that at a 6 week recheck, the gelding had remained fully weight bearing at the walk with slight lameness noted when turning. Stall rest was continued for one month with 15 minutes of hand walking twice daily, lunging in the two months with increased time. With 6 months of training, he continues to be sound and has returned to his original level of use (Madron, Caston, & Kersh, 2013).

Somehow, there was lacking in this study in which follow up of each horses were not complete. There was 83 horses that have no records of the first start post-operative of which 6 were still in their recovery period as the surgery was done at the end of year 2015 (2 months before this study was done). Whereas, 77 of the horses have no starts in which 46 of them had no race records in the system and 31 horses were deregistered from the racing career right after the surgery. This

could be suggestive due to post-operative complications. The complications post-operatvely for arthroscopic may include iatrogenic synovial infection, post-operative synovitis, failure to remove the fragments particularly in cases with multiple fragments, post-operative capsulitis, entheseous new bone and soft tissue mineralization. For arthroscopic guided internal lag screw fixation, the possible complications include implant failure, infection of which osteomyelitis occurs, supporting limb laminitis and as surgery time is often prolonged there may be increased complications associated to anaesthesia.

Arthroscopic surgery has the highest frequency of starts post-operative could be due to type of lesions associated to the treatment were not very severe such as the chip fractures. Whereas for both arthroscopic guided internal lag screw fixation and arthrotomy revealed only 3 and 4 starts respectively may be because the injuries was extensive, hence the horses were not fit to prolonged the longevity of the career. However, this study does not compare the ability of each procedure in returning the ability of the horses to continue the racing career. It is only with the intention to emphasis that arthroscopic surgery with minimally invasive injury may help in restoring the racing capability of the horses.

6.0 CONCLUSION

Based on the results, few conclusions can be drawn concerning the occurrence or frequency of joint surgery, age group and different joint locations, duration to first start and number of start races after surgery and also frequency of lifespan races.

Arthroscopic surgery may provide effective visualization of the lesion intra-articularly within a small surgical incision. This weighs the arthrotomy approaches as arthroscopic surgery is a method of preserving the economic value of an injured Thoroughbred race horses, allowing a rapid and successful return to racing at their previous or higher level of racing performance without hindering the longevity in their career and early retirement is not necessary.

Arthroscopic surgery assists the diagnostic process and may be accurately determine the prognosis and post-surgical management. Therefore, it is recommended for the caretaker to have a good working relationship with a surgeon experienced in treating joint diseases in Thoroughbred racehorses as this will facilitate the surgical decision making process.

7.0 RECOMMENDATIONS

This study could be more beneficial if very accurate diagnoses of the problems are attained through a detailed history, physical examination and radiological findings. Hence, it is recommended to further this study by taking into consideration the details of the established lesions and a follow up post-operative.

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APPENDIX I

Table 1: Occurrence of joint surgery in 8 years from year 2008 to 2015.

Year	Number joint surgery performed	Total number of surgeries performed	Percentage (%)
2008	30	131	22.90
2009	35	145	24.14
2010	46	162	28.40
2011	27	105	25.71
2012	18	94	19.15
2013	22	94	23.40
2014	25	81	30.86
2015	15	46	32.61
TOTAL	218	858	25.41 %

Table 2: Occurrence of joint surgical procedure in 8 years from year 2008 to 2015.

Surgical procedure	Number of surgery	Prevalence (%)
Arthroscopic surgery	181	21.10
Arthroscopic guided internal lag screw fixation	19	2.21
Arthrotomy	18	2.10

Table 3: Number of joint surgery performed in 8 years based on different arthroscopic surgical procedure.

Year	Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy
2008	24	2	4
2009	30	2	3
2010	32	6	8
2011	23	4	0
2012	17	0	1
2013	20	1	1
2014	23	1	1
2015	12	3	0
TOTAL	**181**	**19**	**18**

Table 4: Percentage (%) of different arthroscopic surgical procedure between years.

Year	Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy
	Percentage (%)		
2008	80.00	6.67	13.33
2009	85.71	5.71	8.57
2010	69.57	13.04	17.39
2011	85.19	14.81	0.00
2012	94.44	0.00	5.56
2013	90.91	4.55	4.55
2014	92.00	4.00	4.00
2015	80.00	20.00	0.0

Table 5: Number of cases and frequency of different joint surgical procedures.

Surgical procedure	Number of cases	Percentage (%)
Arthroscopic surgery	181	83.03
Arthroscopic guided internal lag screw fixation	19	8.72
Arthrotomy	18	8.26

APPENDIX II

Table 6: Number of cases and percentage of different joint locations for arthroscopic surgery.

Joint location	Number of cases	Percentage (%)
Right carpal	62	34.25
Left carpal	54	29.83
Both carpal	31	17.13
Right forelimb fetlock	17	9.40
Left forelimb fetlock	11	6.08
Right hindlimb fetlock	1	0.55
Both forelimbs fetlock	4	2.21
Both stifles	1	0.55

Table 7: Number of cases and percentage of different fracture types for arthroscopic guided internal lag screw fixation.

Type of fracture	Number of cases	Percentage (%)
Third carpal slab	11	57.89
Third carpal sagittal	1	5.26
Right forelimb medial sesamoid	2	10.53
Left forelimb medial sesamoid	3	15.79
Left forelimb distal cannon	1	5.26
Lateral condylar	1	5.26

Table 8: Number of cases and percentage of different fracture types for arthrotomy.

Joint location	Frequency	Percentage (%)
Right carpal	2	11.1
Left carpal	1	5.6
R/F fetlock	4	22.2
L/F fetlock	7	38.9
R/H fetlock	4	22.2

APPENDIX III

Table 9: Number of arthroscopic surgical procedures with age group.

Surgical procedure	Juvenile (1-3 years old)	Mature (4-6 years old)	Adult (7-9 years old)	**Total**
Arthroscopic surgery	26	141	14	**181**
Arthroscopic guided internal lag screw fixation	3	15	1	**19**
Arthrotomy	1	13	4	**18**
TOTAL	**30**	**169**	**19**	**218**

Table 10: Number of surgical procedures with number of starts post-operatively.

Surgical Procedure		Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy	TOTAL	Percentage (%)
Frequency	0	63	12	8	83	38.07
	1	7	2	2	11	5.05
	2	11	0	1	12	5.50
	3	8	0	0	8	3.67
	4	11	2	0	13	5.96
	5	10	1	1	12	5.50
	6	8	1	2	11	5.05
	7	10	1	1	12	5.50
	8	6	0	1	7	3.21
	9	2	1	0	3	1.38
	10	5	0	0	5	2.29
	11	6	0	1	7	3.21
	12	2	0	0	2	0.92
	13	3	0	0	3	1.38
	14	1	0	0	1	0.46
	15	5	2	0	7	3.21
	16	3	1	0	4	1.83
	17	2	0	0	2	0.92
	18	2	0	0	2	0.92
	19	2	0	0	2	0.92
	21	1	0	0	1	0.46
	22	1	0	1	2	0.92
	23	1	0	0	1	0.46
	24	2	0	0	2	0.92
	25	2	0	0	2	0.92
	27	1	0	0	1	0.46
	28	1	0	0	1	0.46
	29	2	0	0	2	0.92
	32	1	0	0	1	0.46
	56	1	0	0	1	0.46
	72	1	0	0	1	0.46
	TOTAL	**181**	**19**	**18**	**218**	**100.00**

Table 11: Number of surgical procedures with number of races before surgery.

Surgical Procedure		Race before surgery: Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy	TOTAL	Percentage (%)
Frequency	0	51	8	6	65	29.82
	1	9	2	0	11	5.05
	2	6	0	1	7	3.21
	3	7	0	0	7	3.21
	4	10	2	0	12	5.50
	5	10	1	1	12	5.50
	6	5	1	2	8	3.67
	7	3	1	0	4	1.83
	8	9	0	1	10	4.59
	9	9	1	0	10	4.59
	10	2	0	0	2	0.92
	11	6	0	0	6	2.75
	12	5	0	0	5	2.29
	13	5	0	0	5	2.29
	14	2	0	0	2	0.92
	15	4	2	1	7	3.21
	16	3	1	2	6	2.75
	17	3	0	0	3	1.38
	18	2	0	1	3	1.38
	19	1	0	0	1	0.46
	20	3	0	0	3	1.38
	21	1	0	0	1	0.46
	23	3	0	1	4	1.83
	24	2	0	0	2	0.92
	25	4	0	0	4	1.83
	26	1	0	1	2	0.92
	27	2	0	0	2	0.92
	28	2	0	1	3	1.38
	29	2	0	0	2	0.92
	30	1	0	0	1	0.46
	33	1	0	0	1	0.46
	35	1	0	0	1	0.46
	37	1	0	0	1	0.46
	38	2	0	0	2	0.92
	40	1	0	0	1	0.46
	41	1	0	0	1	0.46
	43	1	0	0	1	0.46
TOTAL		**181**	**19**	**18**	**218**	**100.00**

Table 12: No. of cases of surgical procedure with duration to first start post-operative

Duration to first start						
Surgical Procedure		Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy	TOTAL	Percentage (%)
Frequency / Days	no record	59	10	8	77	35.32
	still rest	4	2	0	6	2.75
	120	6	0	0	6	2.75
	180	3	0	1	4	1.83
	210	22	1	2	25	11.47
	240	19	2	0	21	9.63
	270	22	0	1	23	10.55
	300	19	2	4	25	11.47
	320	7	0	0	7	3.21
	330	8	0	0	8	3.67
	360	6	0	1	7	3.21
	390	2	0	0	2	0.92
	420	1	0	1	2	0.92
	450	2	0	0	2	0.92
	480	1	0	0	1	0.46
	510	0	2	0	2	0.92
TOTAL		**181**	**19**	**18**	**218**	**100.00**

Table 13: Number of cases of surgical procedure with frequency of lifespan races.

Lifespan races						
Surgical procedure		Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy	TOTAL	Percentage (%)
Frequency	0	36	7	6	49	22.48
	1	1	1	0	2	0.92
	2	4	0	0	4	1.83
	3	3	1	0	4	1.83
	4	6	1	0	7	3.21
	5	8	1	1	10	4.59
	6	4	1	0	5	2.29
	7	3	0	0	3	1.38
	8	4	0	0	4	1.83
	9	6	0	1	7	3.21
	10	3	1	0	4	1.83
	11	9	0	0	9	4.13
	12	3	0	1	4	1.83
	13	5	0	0	5	2.29
	14	6	1	1	8	3.67
	15	2	0	0	2	0.92
	16	3	0	0	3	1.38
	17	2	0	1	3	1.38
	18	7	0	0	7	3.21
	19	6	0	0	6	2.75
	20	6	0	1	7	3.21
	21	1	1	1	3	1.38
	22	1	1	0	2	0.92
	23	3	0	0	3	1.38
	24	2	0	0	2	0.92
	25	2	0	0	2	0.92
	26	3	1	1	5	2.29
	27	1	0	1	2	0.92
	28	3	0	1	4	1.83
	29	6	0	1	7	3.21
	30	5	0	1	6	2.75
	31	4	0	0	4	1.83
	32	2	0	0	2	0.92
	33	2	0	0	2	0.92
	34	3	0	0	3	1.38
	35	1	0	0	1	0.46
	37	3	0	0	3	1.38
	41	3	0	0	3	1.38
	43	1	0	0	1	0.46
	44	2	0	0	2	0.92
	45	2	0	0	2	0.92
	49	2	0	0	2	0.92
	61	1	0	0	1	0.46
	75	1	0	0	1	0.46
TOTAL		**181**	**19**	**18**	**218**	**100.00**

Table 14: Number of cases of surgical procedure with age distribution.

Age						
Surgical Procedure		Arthroscopic surgery	Arthroscopic guided internal lag screw fixation	Arthrotomy	TOTAL	Percentage (%)
Frequency / Years old	1	1	0	0	1	0.46
	2	2	0	0	2	0,92
	3	23	3	1	27	12.39
	4	55	4	4	63	28.90
	5	58	9	2	69	31.65
	6	28	2	7	37	16.97
	7	9	0	3	12	5.50
	8	2	1	1	4	1.83
	9	3	0	0	3	1.38
TOTAL		**181**	**19**	**18**	**218**	**100.00**