UNIVERSITI PUTRA MALAYSIA

ASSESSMENT OF AGE, WEIGHT, AND INTEROBSERVER AGREEMENT ON THE THORACIC LIMB REFLEXES IN HEALTHY DOGS IN SELANGOR

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ASSESSMENT OF AGE, WEIGHT, AND INTEROBSERVER AGREEMENT ON THE THORACIC LIMB REFLEXES IN HEALTHY DOGS IN SELANGOR

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CERTIFICATION

It is hereby certified that we have read this project paper entitled "Assessment of Age, Weight, and Interobserver Agreement of the Thoracic Limb Reflexes in Healthy Dogs in Selangor", by Nur Dinah Nur Hardy and in our opinion is satisfactory in terms of scope, quality, and presentation as partial fulfilment of the requirement for the course VPD 4999- Final Year Project.

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Abstrak daripada kertas kerja projek yang dikemukakan kepada Fakulti Perubatam Veterinar untuk memenuhi sebahagian daripada keseluruhan kursus VPD 4999 Projek Ilmiah Tahun Akhir.

PENILAIAN REFLEKS ANGGOTA TORAKS PADA UMUR, BERAT BADAN DAN PERSETUJUAN ANTARA PEMERHATI DALAM ANJING SIHAT DI SELANGOR

Oleh

Nur Dinah Nur Hardy

2022

Penyelia: Dr. Intan Nur Fatiha Shafie

Refleks tulang belakang adalah sebahagian daripada pemeriksaan neurologi yang membantu dalam penempatan lesi. Terdapat pelbagai faktor yang dapat mempengaruhi tindak balas refleks dan penggredan, dan kebolehpercayaan terhadap refleks masih lagi dikaji. Objektif dari kesuluruhan kajian ini adalah untuk mengenalpasi kesan umur dan berat badan dalam pengamatan tindak balas refleks anggota toraks pada anjing sihat. Kajian ini menggunakan sebanyak 30 anjing yang

terdiri daripada 25 ekor anjing jantan dan 5 ekor anjing betina, dari baka yang pelbagai, umur min (7.9 ± 3.98) tahun dan berat badan min (20.86 ± 7.98)kg. Kesemua anjing dibahagikan dalam kumpulan mengikut umur: kumpulan 1, <7 tahun; dan kumpulan 2,>7 tahun dan berat badan: kumpulan 1, <15kg; dan kumpulan 2, >15kg. Seemua anjing adalah sihat pada waktu pemeriksaan. Refleks trisep, refleks extensor carpi radialis dan refleks withdrawal telah ditimbulkan pada kedua dua belah anggota toraks menggunakan tukul refleks semasa anjing posisi rebah lateral sambil dirakam. Kehadiran refleks telah diberi markah oleh tiga kumpulan pemerhati mengikut kepakaran iaitu seorang pakar neurologi, seorang pakar bedah veterinar, dan dua orang pelajar perubatan veterinar. *Fleiss' Kappa Correlation* telah digunakan untuk menganalisis persetujuan antara pemerhati terhadap refleks tersebut. Refleks withdrawal telah dicatat sebagai refleks paling senang ditimbulkan dengan keseluruan nilai Kappa (0.2) yang merupakan markah tertinggi oleh pemerhati. Refleks trisep and refleks extensor carpi radialis mendapat nilai sebanyak (0.06) dan (0.04) yang merupakan persetujuan kurang baik oleh pemerhati. Ujian *Spearman's Correlation* telah digunakan dan tiada hubungan antara umur dan berat badan dengan refleks anggota toraks.

Kata kunci: refleks trisep; refleks extensor carpi radialis; refleks withdrawal; anjing sihat; persetujuan antara pemerhati

ABSTRACT

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

ASSESSMENT OF AGE, WEIGHT, AND INTEROBSERVER AGREEMENT ON THE THORACIC LIMB REFLEXES IN HEALHTY DOGS IN SELANGOR

By

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2022

Supervisor: Dr. Intan Nur Fatiha Shafie

The spinal reflexes are a part of the neurological examination that aids in lesion localization. There are many factors that could influence the reflex response and its grading, and the reliability of the reflexes is still being discovered. This study aims to investigate the effect of age and weight on the intensity of the thoracic limb reflexes and to grade the thoracic limb reflex and to conduct inter-observer agreement on the thoracic limb reflex response in healthy dogs. This study used dogs with 30 dogs

consisting of 25 males and 5 females, various dog breeds with mean age (7.9 ± 3.98) years and a mean weight (20.86 ± 7.98) kg. The dogs were categorized into 1 or 2 groups based on age: group 1, <7 years; and group 2, >7 years and weight into group 1, <15kg; and group 2, >15kg. All dogs were healthy at the time of examination. Triceps reflex, extensor carpi radialis reflex and withdrawal reflex were elicited on both limbs by a hammer reflex while the dog was in lateral recumbency while the processed is video tapped. The reflex presence was scored by three different groups of observers depending on the level of expertise (one neurologist, one veterinary surgeon, and two veterinary students). Fleiss' Kappa Correlation were applied for analysis of inter-observer agreement on the reflexes. Withdrawal reflex being the easiest reflex to elicit with overall Kappa value (0.20) which was the highest (fair agreement) scored by the observers. Triceps and extensor carpi radialis reflex had value of (0.06) and (0.04) which was of poor agreement. Spearman's rank test was used to show that age and weight have no correlation with the reflexes.

Keywords; triceps reflex; extensor carpi radialis reflex; withdrawal reflex; healthy dogs; interobserver agreement

1.0 INTRODUCTION

Neurology examinations have proven to be one the most challenging diagnostic techniques in the veterinary medicine aligning with the advancing technologies such as using MRI as neuroimaging in neurodiagnostic providing explanation of specialized imagine techniques, though unfortunately more expensive and potentially more complicated (Platt & Olby, 2013).

Unlike physical examinations that is essentials in detecting an abnormality in other body systems, neurological examinations on the other hand evaluates the functional integrity of the various components of the nervous system. The examinations can be divided into observations, palpations, postural reactions, spinal reflexes, cranial nerve responses and sensory evaluation (Lorenz et al., 2012).

Spinal reflex evaluation should be considered as a continuation of gait evaluation and postural reaction and not as a sole entity (Platt & Olby, 2013). But in this research healthy dogs that are not diagnosed by factors that could compromises their nervous system are taken as sample and spinal reflexes are performed. The anatomical components of each spinal reflex are specific peripheral sensory nerves, spinal cord segments, motor peripheral nerves and muscles (Procedures Pro). Spinal reflex evaluation is performed to help classify the neurological disorder as either an upper motor neuron (UMN) or lower motor neuron (LMN) type (Simon & Natasha, 2012). It allows the examiner to localize the lesion to specific spinal cord segments or peripheral nerves.

Spinal reflex consists of components for evaluation such as the thoracic limb and the pelvic limb reflexes, whereas the spinal cord can be divided into four regions: cranial cervical (C1–C5), cervicothoracic (C6-T2), thoracolumbar (T3-L3) and lumbosacral (L4-S3). Thoracic limb test is a reflex test performed to assess the spinal reflexes of animals where when a depressed or absent reflexes indicate a lesion in the specific region as well as an exaggerated spinal reflexes as the evidence of lesions present somewhere between the brain and the spinal reflex tested. The triceps tendon and the extensor carpi radialis is tapped with percussion hammer and is evaluated to test C6 to C7 (Aiello & Mays, 2016) while the withdrawal reflex in thoracic limb evaluates the integrity of the C6-T2 spinal cord segment and brachial plexus and peripheral nerves in the thoracic limbs (Palus, 2014).

The objective of this study is to grade thoracic reflex response: triceps, extensor carpi radialis and withdrawal (flexor) reflexes in healthy dogs as well as to investigate the effect of age, and weight on the intensity of thoracic limb reflexes as well as to analyze the interobserver agreement on the spinal reflex in thoracic limb in healthy dogs. The evaluation of reflexes in neurological examination is highly subjective despite it developing rapidly in the veterinary medicine. Compared to our human counterparts, there is lack of data on the effect of intrinsic factors on the thoracic limb reflexes in dogs although the reliability of pelvic limb reflex tests is mentioned often in research.

Identifying and quantifying the factors which influence grading reflexes in dogs allows for practitioners to communicate clinical examination findings more

effectively during case discussions and to have comparable evaluation methods is becoming important to cater with the demand from pet owners. This study examines data of healthy working dogs collected from the K9 Detection Unit Fire and Rescue Department Taman Sri Sentosa, and seven other healthy pet dogs around Selangor.

2.0 LITERATURE REVIEW

2.1. Thoracic Limb and their Nerve Supply

Thoracic limb is needed to be separated from the trunk for further dissection to identify the spinal nerves C6-T2 which forms the roots of the brachial plexus in which the ventral branches of these several spinal reflexes intermesh with an exchange of fibers. The major nerves of the thoracic limb originate as branches of the brachial plexus (Budras, K. D., 2010). According to Miller (1952) the brachial plexus of the dog originates from the ventral divisions of the sixth, seventh, and eighth cervical spinal nerves and the first and second thoracic spinal nerves. As Bowne (1959) state the real trunk of cord formation cannot be distinguished in dogs and that the roots break up into anterior and posterior divisions shortly after they emerge from the intervertebral foramina. Miller (1934) further states that this type of plexus accompanies shoulder muscles that have undergone various adaptive changes coincidental with the lack of a clavicle.

As Bowne (1959) described in his experiments that transecting the suprascapular nerve produces no visible lameness in the dog although it is supplied to the supraspinatus and infraspinatus muscle whereas the loss of extensors of the shoulder can be achieved by the transection of the deep pectoral biceps brachii and the brachiocephalicus. The long head of the triceps brachii and latissimus dorsi may compensate for the loss of the flexors of the shoulder while when he transected the radial nerve below its branches to the triceps brachii the reaction to the leg does not show the same symptom as to when the radial nerve high in the plexus result in the leg bearing no weight because none of the other joints in the shoulder can be extended.

The neural organization of gait and posture is complex, involving all levels of the nervous systems with the limbs maintained is extension for supporting weight by spinal cord reflexes and that stepping movements are also programmed at the spinal level (Lorenz et al., 2012).

2.2. Evaluation of the Thoracic Limb: Withdrawal (flexor) reflex

As mentioned in the Lorenz et al., (2012), the flexor reflex is more complex than the myotatic reflex where it involves all the flexor muscles of the limb and thus requires activation of motor neurons in several spinal cord segments. It further describes the branches of the radial nerve innervating the cranial surface of the foot and arise from spinal cord segments C7-T1. But described differently in (Simon & Natasha, 2012) the withdrawal flexor reflex evaluates the integrity of spinal cord segments C6-T2 and its associated nerve roots as well as the brachial plexus and peripheral nerves such as the axillary, musculocutaneous, median, and ulnar nerves.

The principal functions of the deltoideus and cleidobrachialis muscles are flexion of the elbow joint, respectively (Bergadano 2006). She further discussed that the response of the limb evoked by when a stimulation is applied it could be compared with the withdrawal movement overcoming obstacles during deambulation where the initial movement is a flexion of the shoulder joint together with a locking of the elbow joint and dorsiflexion of the carpus, activating the muscles.

The withdrawal flexor reflex of the thoracic limb is tested by pinching the skin between the digits where the normal response is flexion of the carpus, elbow, and shoulder. This is a reflex mediated at the level of the spinal cord and does not indicate the conscious perception of pain which happens at a cortical level (Dewey, 2016). Pinching of the digits needs to be performed and the flexion of all joints is a normal response (Palus, 2014).

2.3. Evaluation of the Thoracic Limb: Extensor carpi radialis reflex

The extensor carpi radialis muscle starts as it leaves its insertion on the humerus, the muscle stretches dorsally with respect to the radius, then continues as a double tendon which crosses dorsally the articulation of the carpus and finally has its insertion on the metacarpals (Cossu et al 2000). It further described the innervation of the extensor carpi radialis muscle is by some branches of the radial nerve and can distinguish two branches which innervate the muscle on its proximal and internal face and a branch which is common with the extensor digitorum communis muscle. The extensor carpi radialis reflex is tested by striking the extensor carpi radialis muscle belly with a reflex hammer at the proximal region of the antebrachium whilst the carpus is slightly flexed (Simon & Natasha, 2012). This reflex evaluates the integrity of spinal cord segments C7-T2 and associated nerve roots as well as the radial nerve. A normal response is a slight extension of the carpus although this may not be a true myotatic reflex and be just a muscular response because it can be elicited in dogs with a transected radial nerve (Dewey, 2016).

Of the two extensors of the carpal joint both are named extensors, only the extensor carpi radialis functions as an extensor of the joint, the extensor carpi radialis muscle ends by dividing into two tendons that insert proximally on metacarpal bones II and III (Budras, K. D., 2010).

2.4. Evaluation of the Thoracic Limb: Triceps reflex

The extensors of the elbow are the triceps and anconeus (Alexander, 1974). He further described that the triceps has three parts of which the largest is the long head and bipinnate proximally but unipennate distally. The long head of the triceps originates on the scapula and the other parts on the humerus (Alexander, 1974). The triceps brachii muscle extends the elbow and is essential for weight bearing in the forelimb and is innervated through the radial nerve with the origin from spinal cord segments C7-T1 in the dog (Lorenz et al., 2012). The triceps reflex is performed by grasping the antebrachium, flex the elbow, and rotate the shoulder medially inward so that the elbow joints is abducted (Dewey, 2016). The triceps tendon is then strike on the medial surface, above the olecranon. The triceps reflexes are less reliable than the withdrawal and extensor carpi radialis reflexes and are not aways present in the normal animal (Simon & Natasha, 2012).

The desired reaction is extension of the elbow or carpus. Spinal reflexes such as extensor carpi radialis reflex, biceps brachii and triceps reflex, cranialis tibialis and gastrocnemius reflex can be used in neurological examination of small animals although they are generally less reliable (Palus, 2014). The assessment of some of the reflexes are thought to have a high degree of reliability such as flexor reflex whilst other are depicted to be of low reliability like the triceps tendon reflex (Giebels et al, 2019).

2.5. Effect of Age, and Weight on the Intensity of the Reflexes

Aging has been defined as progressive reduction in the ability of an organism to meet the demands of the environment (Mosier 1977). He further described that generally aging results in or occurs simultaneously with the loss of organ reserve, regenerative powers of organ function, and adaptability. In the integumentary system, Mosier (1977) describes older dogs in their one third of their life have hair that is dull and lusterless, with areas of alopecia and callus formation whereas the skin becomes less pliable with increased calcium content and pseudoelastin in the elastin fibers resulting in the loss of elasticity of the skin. He further elaborates how aging in dog results in lower levels of serotonin leading to depression, sleep disorders, and some neuromuscular disorders although the loss of certain reflexes may have diagnostic value in the young and mature dog, they lose significance in the aged dog and will generally have reduced reaction to stimuli and partial loss of sensation. Furthermore, tremor and motor hesitancy results from impairment of the corpus stratum and corpus pallidius.

Moreover, veterinary practitioners are fully familiar with a cognitive dysfunction syndrome in aged dogs characterized by behavioral changes such as decreased activity and attention span, sleep cycle disturbances, disorientation, and loss of previous housetraining (Borras *et. al.* 1999). Their researched mentioned of wide variety of age-related changes described in the nervous system of many species and most are considered incidental findings, however, and their functional consequences remain poorly understood. Borras *et al* (1999) explained that fibrosis and patchy calcifications of meninges and choroid plexus may be viewed as benign age-related

changes without clinical consequences, although dural osseous metaplasia of the spinal cord in old dogs has been thought to induce neurological impairment in some cases, and the role of these findings in canine cognitive dysfunction syndrome remains unknown and needs further study. In some older dogs the reflexes can be weak with no clinical significance (Palus 2014).

In an experiment using mongrel dog conducted by Yashon & Whisler (1967), their data showed no correlation between brain weight and body weight is possible and that the same is true of brain volume and body weight. They further mentioned how the practice of assuming brain and body weight relationship should be discouraged in scientific investigation, it does not show significant correlations with either the body weight or the body length but is significantly correlated with the weight of the spinal cord (Yashlon & Whisler 1967). As mentioned in a study done by Rocchini et al (1987), their findings concluded weight gain in dogs associate with an increase in heart rate, blood pressure, cardiac output, plasma volume and fasting insulin concentration but none affecting the nervous system nor the spinal cord.

As mentioned by Loderstedt et al. (2014) in his experiment, none of the parameters of sex, age, weight, fur length or examiner show a significant influence on the interobserver agreement of the reflex presence. He further explained that none of the examined parameters influenced the interobserver-agreement in any three groups which are the examining person, the examined subject, and the examination itself.

2.6. The Reflex Grading System

Spinal reflexes assess the integrity of the sensory and motor components of the reflex arc and the influence of descending UMN motor pathways. Reflexes are graded as follows: absent, weak (present but reduced), normal, exaggerated, clonus (repetitive flexion and extension of the joint in response to a single stimulus). These grades are translated into numbers used to fill the neurologic examination form. A normal reflex is graded as “2”, whereas a decreased reflex is assigned “1”, an absent reflex “0”, an increased “3”, and a clonic reflex “4”.

A lesion affecting any part of the reflex arc, including the peripheral nerve, nerve roots, spinal segments, neuromuscular junction, and muscle. Other signs of weakness are usually apparent. Severe rigidity or muscle contraction that limits joints movement, such as fibrosis of a joint or muscle. Absent muscle stretch reflexes can also be seen in normal animals that are excited or unable to relax (Dewey, 2016).

3.0 MATERIALS AND METHODS

3.1. Source of Data

In this study, 31 dogs were used as sample, in which 23 dogs were taken sample from the K9 Detection Unit Fire and Rescue Department Taman Sri Sentosa, three dogs were the University Veterinary Hospital (UVH) resident dogs, and four dog samples were taken from Tan Eeling's house pet dog. 30 dogs of different breeds with age ranges from two to 14 years old, a wide range of weight from 3kg to 41kg and fur length of 1.2cm to 4.8cm were chosen as sample. Including criteria were a normal clinical, orthopedic, and neurological examination and no history of neurological disorders. Physical examinations were done by Assoc. Prof. Dr. Lau Seng Fong, the neurological examination were done by Dr. Nur Intan Fatiha Shafie and the thoracic limb reflexes were done by me. Only the process of thoracic limb reflexes were videotaped, while the dogs on lateral recumbency, using same reflex-hammer and same ruler used for fur length measuring. Firstly, the history of the dogs was obtained, and physical examinations were performed. A complete neurological examination was also performed consisting of observation of the posture and body position, evaluation of gait, hands on examination such as cranial nerve examination, and postural reactions.

For the spinal reflexes, the dogs were put in lateral recumbency of one side. Thoracic limb of triceps reflexes was performed by grasping the antebrachium, flex the elbow, and rotate the shoulder medially so that the elbow joints is abducted. The triceps tendon was strike on the medial surface above the olecranon. Next the extensor carpi radialis reflex were done by holding the antebrachium, supporting the limb under

the elbow, keeping the elbow flexed. The belly of the carpi radialis muscle just distal to the elbow was strike with the reflex hammer. Lastly, the withdrawal (flexor) reflex was done with the limb extended, pinch the interdigital skin lightly with our fingers. The same thoracic limb reflexes were done on the other side of the limb as well.

There were four observer/graders involved in this study, being the Grader 1 is of an expert clinician in neurology, Grader 2 is a veterinary surgeon and Grader 3 and Grader 4 were veterinary students. All graders were given a grading form and evaluated the anonymized video in the same manner. Each grader evaluated if the reflex was present or absent (0=absent, +1=present but weak, +2=normal, +3=exaggerated response, and +4=clonus with repetitive and extension of joint in response to a single stimulus). A total of sixty thoracic limbs were examined with three thoracic limb reflexes each by four graders.

3.2. Statistical Analysis

For statistical data analysis SPSS Statistics (IBM) were used. Examination of histogram and descriptive statistics indicated that the distributions of both age and weight (considered a possible confounding variable) were not gaussian, and nonparametric statistical methods were used. Associations between age and weight to the presences of triceps, extensor carpi radialis and withdrawal reflex responses were tested by Spearman rank-order correlation coefficient (Spearman's correlation) by creating a scatterplot to analyze the relationship of the reflexes to the age and weight. The association between triceps reflex, extensor carpi radialis reflex and withdrawal reflex with the interobserver agreement were tested by Fleiss' Kappa Analysis after checking the scatter diagram between them to confirm that a linear association was a reasonable assumption. All Kappa-coefficient were interpreted following Landis and Koch with <0.20 = *poor*, 0.21 – 0,40 = *fair*, 0.41 – 0.60 = *moderate*, 0.61 – 0.80 = *good*, 0.81 = 1.00 = *very good*. The dogs were subdivided into groups depending on sex, and weight. The interobserver agreement was set as dependent variable, all others were covariates. P <0,05 was considered significant.

4.0 RESULTS

4.1. Demographic Profile

Data obtained from the 30 samples were divided into two categories. 25 dogs were male, and 5 dogs were female. For age, 18 dogs aged less than 7 years old, and 12 dogs were of more than 7 years old. 10 dogs weight less than 15kg and 20 dogs weight more than 15kg. these were summarized in Table 1. All the 30 dogs were sampled for triceps reflex, extensor carpi radialis reflex and the withdrawal (flexor) reflex.

Table 1: Subdivision of the 30 dog samples.

n = 30		
Sex	Male	25
	Female	18
Age	Less than 7 years old	18
	More than 7 years old	12
Weight	Less than 15 kg	10
	More than 15 kg	20

Out of the 30 sampled dogs, 23 of them were completely healthy while 7 of the dogs were healthy with other non-neurological issues such as aural hematoma, abnormal heart sound, hip issue, some were on heart medication, long term CLUTD, stiffness and autoimmune skin diseases, which one of these issues has any direct influence on the reflex response. The breeds involved in the samples were 13 springer spaniels, 6 Labradors, 5 local dogs, 2 toy poodle, and one each of cockle spaniels, German pointer, border collie, and Malinois.

4.2. Review on the Reflex Grades with Age and Weight

The review on the reflex grades with age were tested using Spearman's correlation. With R^2 value of 0.192 for triceps reflex, 0.154 for extensor carpi radialis reflex, and 0.010 for withdrawal reflex, the R^2 value showed no significance of the reflexes to the age of the dog (Table 2).

Table 2: Spearman's correlation was used to test the significance of the thoracic limb reflexes with the age of the dogs.

Spearman's rho	Triceps reflex	Extensor carpi radialis reflex	Withdrawal reflex
Age	0.192	0.154	0.01

On a scatter plot diagram, triceps reflex shows a weak correlation were as the age increase, the triceps reflex increases (Diagram 1)

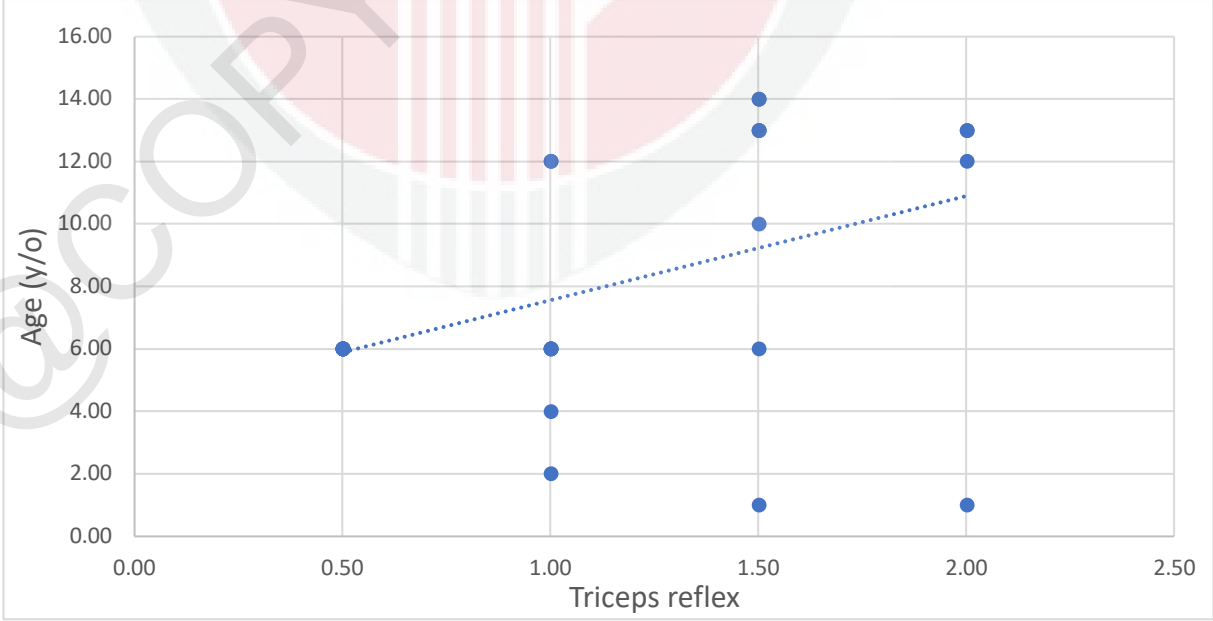

Diagram 1: Scatterplot diagram of triceps reflex increases with age of dogs with R^2 value of 0.192.

Table 3: Spearman's correlation was used to test the significance of the thoracic limb reflexes with the weight of the dogs.

Spearman's rho	Triceps reflex	Extensor carpi radialis reflex	Withdrawal reflex
Weight	0.019	0.001	0.007

Then, Spearman's correlation was used again to test the significance of the three reflexes with the weight of the dog (Table 3). The value of R^2 for triceps reflex is 0.019, extensor carpi radialis reflex is 0.001 and 0.007 for withdrawal (flexor) reflex. Thus, both age and weight showed no influence on the reflex grading.

4.3. Graders Feedback on Reflex Grading and Interobserver Agreement

Among the 4 graders involved in the grading the thoracic limb reflexes, it was agreed that triceps reflex was the hardest reflex to elicit and grade while withdrawal (flexor) reflex was the easiest reflex to elicit and grade. Based on Diagram 2, out of 60 thoracic limb, withdrawal reflex recorded the highest common agreement on limbs showing normal response at 54.32, then the extensor carpi radialis reflex second highest common agreement at 36.25 and triceps reflex had the lowest common agreement on reflexes among the graders recorded only at 25.5.

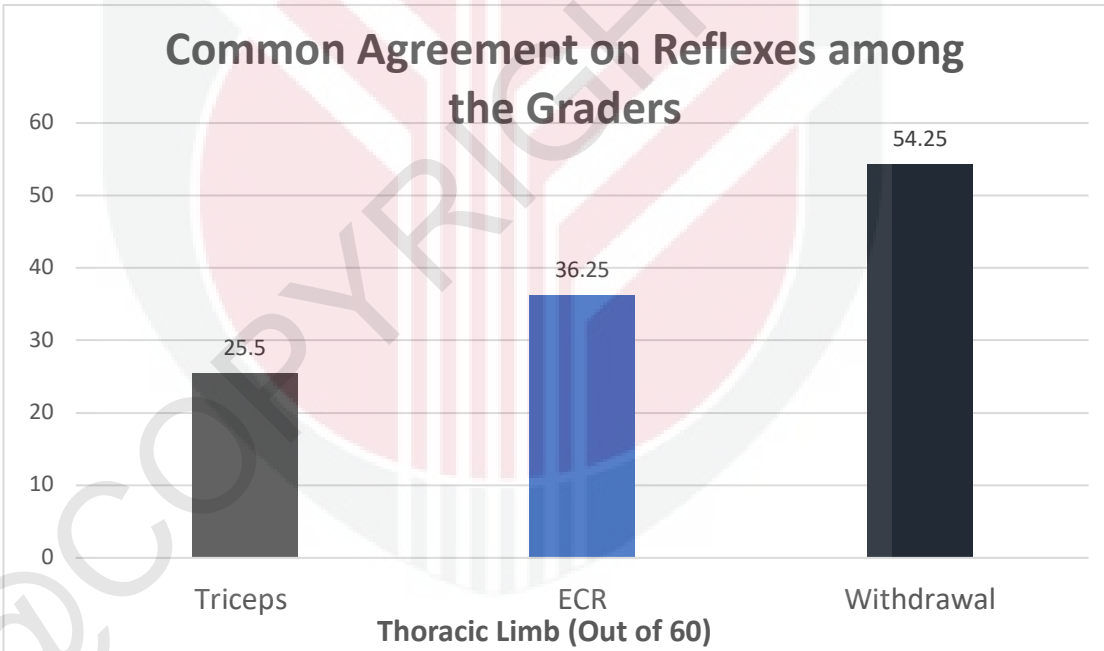

Diagram 2: A bar graph showing common agreement on the sixty thoracic limb reflexes that showed normal response among the four graders.

Fleiss' Kappa Analysis measure of inter-grader agreement used to determine the level of agreement between the four graders when the method of assessment is measured on a categorical scale. The overall kappa value shows triceps reflex and

extensor carpi radialis reflex being in poor agreement with 0.06 and 0.04 as compared to withdrawal reflex that is in fair agreement with kappa value of 0.2. Based on the statistical data, withdrawal does have the highest interobserver agreement compared to other reflexes (Table 4).

Table 4: Fleiss' Kappa analysis was used to measure between the interobserver agreement between the four graders and the thoracic limb reflexes.

Overall Kappa value, k	Triceps reflex	0.06	Poor agreement
	Extensor carpi radialis reflex	0.04	
	Withdrawal reflex	0.2	Fair agreement

5.0 DISCUSSION

According to Palus (2014), making a correct diagnosis and to recommend the appropriate treatment from neurological conditions is not possible without CT or MR but having a basic neurology knowledge is often necessary in order to make an educated judgement about the most likely diagnosis and severity of the condition as well as the prognosis. In a study conducted by Giebels et al. (2014), the reflexes in humans could also rely in the change in the hammering angle and the maximum angular acceleration. They also further suggested that neither sex, weight, age, and fur length influence the reflexes.

As being shown in the results from this study, the factors such as age, and weight have a higher P value than 0.05 after being tested using Spearman's correlation tests thus this means to accept the null hypothesis. Even when the factors such as age, and weight were categorized into two; more than 7 years old and dogs of less than 7 years old, dogs weighing less than 15kg and dogs weighed with more than 15kg, all results were all the same. Therefore, there is not significant relation between the age, and weight with the thoracic limb reflexes.

The gradings from Grader 1, a clinician expert in neurology, was chosen to be tested with Spearman's correlation. This is due to the it being more reliable than the other Graders with lesser experience in grading reflexes. And as shown in the results, although Diagram 1 shows a weak correlation between triceps reflexes with the age of the dog where, the reflexes increases as the dog is older, there is doubts regarding the reliability of tendon reflexes in the thoracic limbs as stated by De Lahunta and

Glass (2009). It could have been due to the small sample size where the result can not represent the whole population. Instead, other than the variability in interobserver variability, other factors such as the positioning of the subject, their intramuscular temperature and muscle tone as well as increased fear or anxiety of the subject might influence the neurological examination of the thirty dogs.

The difficulty in performing the triceps reflex could be due to dogs being in a state of nervousness thus it is contracting the limb muscles. Another factors that could alter the reflex grading after the limb reflexes could be how the dogs were having a rapid breathing resulting in the unconscious movement of the thoracic limb that is directly connected to their chest; the limb is in constant moving altering the supposed slight extension of the limb when being hit at the triceps tendon with the reflex hammer. The triceps reflex is considered to be the hardest reflex test to perform for the thoracic limb as it is also being mentioned by Palus (2014) that triceps reflex and extensor carpi radialis reflex can be used but are generally less reliable for localization. Therefore it can be said that factors such as the position of the dog, the increased muscle tone and others could influence the thoracic limb reflexes, instead of it being influenced by the age and the weight of the dog.

Again, being mentioned in Palus (2014), the most reliable spinal reflexes of the limbs that are used in small animals are withdrawal reflexes of thoracic and pelvic limbs by pinching of the digits, the flexion of all joints is considered to be a normal response. The easiest thoracic limb reflex to be performed on dogs would be the withdrawal reflex, as expressed in Diagram 2.

The evaluation of the reflex answer is considered to be an essential tool for the neurological examination despite its highly subjective nature. Based on the feedbacks from the graders on the reflex gradings, common agreement was achieved that triceps reflex is the hardest reflex to elicit and grade whereas the withdrawal reflex is the easiest reflex to elicit and grade. Our results represent a widely discussed problem in medicine which is the interobserver agreement of subjective evaluations.

With only clinically healthy dogs based on history and neurological examination, it is important to mention that the integrity of the reflex arcs was not verified with advanced diagnostic tools such as magnetic resonance imaging and electromyography, therefore the results could lack validity and is considered during the interpretation of the results. Although the dogs are healthy and should represent a reliable reflex with perfect agreement from the observers, as mentioned by Giebels et al. (2019), it is highly unlikely in medical studies, where especially when the accuracy of the reflexes in detecting a lesion within their reflex arc was not the aim of the study.

To support the feedbacks from the graders on the grading reflexes, Fleiss' Kappa analysis was used. The results of our study represented with fair agreement with 0.20 for withdrawal reflex and poor agreement for both triceps reflex and extensor carpi radialis reflex with 0.06 and 0.04 overall Kappa value. The interpretation of Kappa generally follows the model of Landis and Koch and so its values are comparable between the studies with the consideration of the respective study design.

As mentioned by Loderstedt et al. (2014), there is assumption on the increase of interobserver agreement through trainings of the examining person. And in this study, Grader 3 was also the person elicited the thoracic limb reflexes after going several sessions of trainings by the expert. There could have been bias as to the gradings from Grader 3, which is as they expressed saying that there could be high interobserver variability in the study where the examiner was also the observer. However, in Dafkin et al. (2013), there is no found correlation between the accuracy of reflex assessment and the observer's level of expertise.

6.0 CONCLUSION

The withdrawal (flexor) reflex has the highest interobserver agreement compared to triceps reflex and extensor carpi radialis reflex in healthy dogs. Withdrawal (flexor) reflex is the easiest reflex to grade compared to the rest. Neither age nor weight have any correlation with the thoracic limb reflexes in healthy dogs.

7.0 RECOMMENDATIONS

i. Increasing sample size could represent the dogs in Selangor.

ii. To grade the elicited reflex response during the examination and to conduct an intra-observer agreement to increase reflex reliability.

iii. To include more expert clinicians in neurology to reduce variability in grading reflex.

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