

## RESEARCH ARTICLE

# Effect of Exercise on Electrocardiography and Stress Behavior of Kangal Shepherd Dogs with Ankyloglossia

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## Abstract

Effect of exercise has been studied on electrocardiography and stress behavioral parameters of 12 male Kangal shepherd dogs with ankyloglossia and 15 male Kangal shepherd dogs without ankyloglossia were compared. In this study, electrocardiography recordings were obtained from Kangal shepherd dogs with the holter device at resting state and during 15-min exercise. All data collection were conducted in the same environmental condition. In addition, behavioral parameters captured with a video camera during resting state and the end of 15-min exercise period. While no statistical difference was detected in two groups in terms of all electrocardiographic parameters at resting state, statistical differences were detected in both groups in the P wave amplitude, T wave amplitude, duration of PR interval, duration of QT interval and heart rate parameters during exercise. Following 15-min of exercise, all stress parameters were observed in dogs with ankyloglossia, while only two parameters were observed at resting state. Following a 15-min exercise, without ankyloglossia dogs showed only two stress parameters, while no parameters were observed at resting state. This study will have an important area in the literature in terms of examining the electrocardiographic data and stress behavioral parameters of Kangal shepherd dogs with ankyloglossia.

**Keywords:** Ankyloglossia, Behavior, Exercise, Holter, Kangal shepherd dog

## Ankloglossia Olan Kangal Çoban Köpeklerinde Egzersizin Elektrokardiyografi ve Stres Davranışı Üzerine Etkisi

### Öz

Ankyloglossia olan 12 adet erkek Kangal köpeği ve ankyloglossia olmayan 15 adet erkek Kangal köpeğinde elektrokardiyografi ve stres davranış parametreleri üzerine egzersizin etkisi karşılaştırılmıştır. Bu çalışmada elektrokardiyografi kayıtları Kangal çoban köpeklerinden aynı çevre şartlarında dinlenme ve 15 dakikalık egzersiz sırasında holter cihazı ile alınmıştır. Ayrıca dinlenme ve 15 dakikalık egzersiz sonundaki davranış parametreleri video kamera ile kayıt edilmiştir. İki grupta dinlenme durumunda elektrokardiyografik parametrelerin yanında istatistiksel olarak fark bulunmazken, egzersiz sırasında P dalgası amplitüdü, T dalgası amplitüdü, PR aralığı süresi, QT aralığı süresi ve dakika kalp atımı sayısı parametrelerinde istatistiksel olarak farklılık bulundu. Ankyloglossialı köpeklerde dinlenme durumunda sadece iki stres parametresi gözlenirken 15 dakikalık egzersizi takiben tüm stres parametreleri gözlemlendi. Ankyloglossia olmayan köpeklerde dinlenme durumunda stres parametreleri gözlemlenmezken 15 dakikalık egzersizi takiben sadece iki stres parametresi gözlemlendi. Bu çalışma ankyloglossialı Kangal çoban köpeklerinin elektrokardiyografik verilerini ve stres davranış parametrelerini incelemesi yönünde literatürde önemli bir yere sahip olacaktır.

**Anahtar sözcükler:** Ankyloglossia, Davranış, Egzersiz, Holter, Kangal çoban köpeği

## INTRODUCTION

Kangal shepherd dogs are highly valued as livestock guard dogs because of their large size, agility, imposing appearance and the fact that they are brave enough to confront greater savage animals than themselves. Moreover, they are highly

valued as guard dogs because they are loyal to their owners and harmless and well-disposed toward children and weaker animals<sup>[1-3]</sup>. As guard and shepherd dogs, Kangal Shepherd dog breed is present in variety of different countries in the world and, in some countries like in the US, Belgium, and France, breeding is also present<sup>[2]</sup>. Due to their

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loyalty and excellent awareness the Kangal Shepherd Dog breed is thoroughly preferred as guard dogs. This breed is known to have a profound adaptability to various climatic changes by their excellent thermoregulatory mechanisms. The tongue is of particular importance as a sensory organ for this breed, which primarily takes key roles in regulation of the body temperature. Also the tongue plays a major role in eating, sucking, making sounds and adjusting the body temperature in dogs [4]. Congenital and acquired diseases of the tongue include aglossia, microglossia, ankyloglossia, and lingua bifida. Of these, the most common congenital disease is ankyloglossia [5]. Ankyloglossia is a rare condition observed in humans and Kangal dogs [6]. The frenulum linguae, a small fold of mucous membrane that connects the tongue to the base of the mouth, cannot be completely separated from the base of the mouth or it cannot be thickened by cell proliferation, and this, prevents the separation of the tongue [7]. Electrocardiography (ECG) is a method that includes the recording and interpretation of action potentials during cardiac activity and provides information on the current electrical activity of the heart, and to some extent, its functional status [8]. The ECG method can be used in dogs to obtain information about many physiological conditions related to the heart [9,10].

Therefore, the aim of this study was to compare ECG data and stress behavioral parameters during resting state and exercise periods in Kangal shepherd dogs with and without ankyloglossia.

## MATERIAL AND METHODS

### Ethical Statement

This study was approved by the Sivas Cumhuriyet University Animal Experiments Local Ethics Committee (Approval no: 65202830-050.04.04-226 and date 06.12.2018).

### Animal Materials

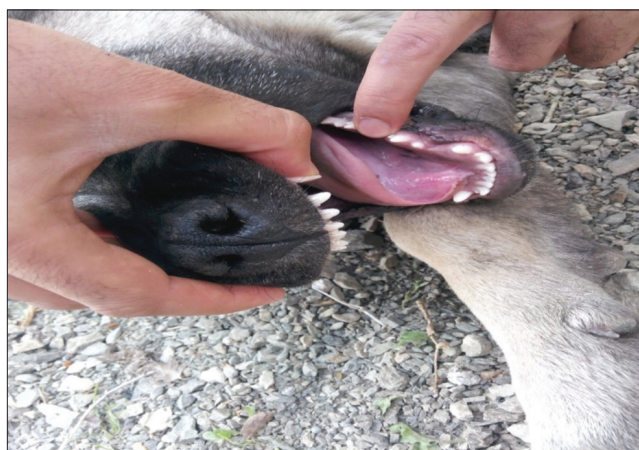
The animal material of the study was composed of 27 healthy male Kangal shepherd dogs; 12 of which had ankyloglossia (Fig. 1) and 15 did not have ankyloglossia. The dogs used in the study, total to 27, of which 24 were in the Kangal Shepherd Dog Breeding Center and 3 were in the hands of independent breeders. Among the 24 dogs in the center, 15 were without ankyloglossia and 9 with it, whereas the 3 dogs from breeders were all with ankyloglossia. All dogs were older than 18 months of age.

### Exercise Program

Dogs were run with their owners at a pace of 3.2 km/h in average for 15 min during the air temperature was 24°C [11].

### Electrocardiographical Parameters

In this study, ECG recordings were obtained with a Holter



**Fig 1.** A Kangal shepherd dog with ankyloglossia

device (Televet II) from the Kangal shepherd dogs during resting state and during a 15-min exercise at the same environmental condition (temperature (24°C), altitude (5050 ft=1540 m), standard dog diet and *ad libitum* watering). In ECG recordings of all dogs, the last 1 min of the 15-min exercise was considered to determine the effect of the exercise. The ECG data were recorded in resting state dogs for 5 min and the last 1 min was taken into evaluation. The Holter device and electrodes were fixed with net bandages, and a test was conducted to prevent stress in the dogs.

Aqua-wet gel electrodes and a recording device (KRUUSE ECG-HOLTER) were placed in the thorax of the animals by the procedure proposed by the manufacturer and fixed with net bandages, and standard derivations I, II, III were printed. Second derivation of the obtained electrocardiograms, P wave duration and amplitude, QRS complex duration, Q and R wave amplitudes, T wave time and amplitude, the duration of PR, QT and ST intervals and heart rate were determined.

### Stress Behavioral Parameters

Both the resting state and at the end of the 15-min exercise periods, stress behavioral parameters of all dogs were captured with a video camera. Subsequently, these recordings were analyzed and evaluated using an ethogram that described stress behavioral parameters in dogs [2]. In the study, the "focal animal sampling" method was used [12]. The method was based on following a particular dog for a certain period of time and counting the behavior shown. Both the ECG and video recordings of the dogs were taken at the same environmental condition while the Kangal shepherd dogs followed their daily routines.

### Statistical Analysis

For the statistical analyses of study parameters the Mann-Whitney U test was used. Also the summary statistics was calculated. All tests were calculated by SPSS v.15 package

program <sup>[13]</sup>. Observed stress behavioral parameters in each group were expressed as a percentage of the number of animals.

## RESULTS

The difference between the resting state ECG data of Kangal shepherd dogs with ankyloglossia and without ankyloglossia was shown in *Table 1*. No statistically significant difference was detected in the resting state ECG data of Kangal shepherd dogs with ankyloglossia or without ankyloglossia. The difference between the ECG data during exercise status of Kangal shepherd dogs with and without ankyloglossia was demonstrated in *Table 1*. When the ECG data during exercise of Kangal shepherd dogs with and without ankyloglossia were compared; statistically significant differences were found in the P wave amplitude, T wave amplitude, duration of PR interval, duration of QT interval and min heart rate. It was determined that P wave amplitude was significantly

increased in Kangal shepherd dogs with ankyloglossia ( $P<0.001$ ). It was detected the T wave amplitude was significantly increased more in Kangal shepherd dogs without ankyloglossia ( $P<0.05$ ). It was verified the duration of PR interval was significantly shorter in Kangal shepherd dogs with ankyloglossia ( $P<0.01$ ). It was also determined the duration of QT interval was significantly shorter in dogs with ankyloglossia ( $P<0.01$ ). It was determined that in dogs with ankyloglossia the increase in heartbeats per minute was statistically significant compared to without ankyloglossia ( $P<0.001$ ).

Stress behavioral parameters at resting state of Kangal shepherd dogs in both groups at resting state were shown in *Table 2*. Some of the stress behavioral parameters that included hind between legs, lowering the body position were observed in Kangal shepherd dogs with ankyloglossia. However, no stress behavioral parameters were observed in Kangal shepherd dogs without ankyloglossia. Stress behavioral parameters exhibited by Kangal shepherd dogs in both groups at the end of 15-min exercise duration were

**Table 1.** Effect of resting state and exercise on ECG findings of Kangal shepherd dogs with and without ankyloglossia

Resting ECG With Ankyloglossia (n=12)	Resting ECG		Exercise ECG	
	Without Ankyloglossia (n=15)	With Ankyloglossia (n=12)	Without Ankyloglossia (n=15)	With Ankyloglossia (n=12)
P wave duration (ms)	0.03807±0.00043	0.03767±0.00035	0.03800±0.00042	0.03758±0.00036
P wave amplitude (mV)	0.1760±0.00321	0.1767±0.00355	0.2013±0.00350	0.2383±0.00386***
QRS complex duration (ms)	0.0500±0.00324	0.0492±0.00229	0.0507±0.00330	0.0508±0.00313
R wave amplitude (mV)	1.6000±0.05024	1.6292±0.04240	1.6033±0.04987	1.6625±0.03899
Q wave amplitude (mV)	0.2680±0.01079	0.2692±0.00484	0.2713±0.01041	0.2692±0.00484
T wave duration (ms)	0.0500±0.00324	0.0500±0.00302	0.0500±0.00324	0.0508±0.00313
T wave amplitude (mV)	0.3487±0.02070	0.3375±0.02863	0.3560±0.01997	0.3083±0.00944*
PR intervals duration (ms)	0.1207±0.00316	0.1200±0.00302	0.1000±0.00378	0.0792±0.00288**
QT intervals duration (ms)	0.2067±0.01436	0.2058±0.00783	0.1840±0.01013	0.1425±0.00566**
ST intervals duration (ms)	0.1400±0.00239	0.1392±0.00336	0.1407±0.00248	0.1383±0.00271
Heart rate (BPM)	114.80±0.863	114.92±0.543	120.67±0.826	125.58±0.763***

Mean±SEM; Mann-Whitney U test \* $P<0.05$ , \*\* $P<0.01$ , \*\*\* $P<0.001$ ; mV: millivolt; ms: milliseconds

**Table 2.** Stress behavioral parameters during resting state and exercise (at the end of 15 min exercise) on Kangal shepherd dogs with and without ankyloglossia

Stres Behavior	Resting Phase		Exercise for 15 min	
	Without Ankyloglossia (n, %)	With Ankyloglossia (n, %)	Without Ankyloglossia (n, %)	With Ankyloglossia (n, %)
Tail between hind legs	0	1 (8.33)	2 (13.33)	5 (41.66)
Lowering the body position	0	1 (8.33)	3 (20)	6 (50)
Yawning	0	0	0	3 (25)
Groovy appearance below the eyes	0	0	0	2 (16.66)
Strained lips	0	0	0	3 (25)
Avoidance	0	0	0	2 (16.66)



**Fig 2.** Some stress behaviour parameters in Kangal shepherd dogs with ankyloglossia after exercise

shown in [Table 2](#). Stress related behavior was observed as increased in both groups at the end of 15-min exercise period. Notably, stress behavioral parameters (strained lips, avoidance, yawning, lowering the body position, tail between hind legs and groovy appearance below the eyes) increased in dogs with ankyloglossia at the end of 15-min exercise ([Fig. 2](#)). In addition, it was determined that the number of Kangal shepherd dogs with ankyloglossia exhibiting the behavior in the same stress behavioral parameter is higher than the number of Kangal shepherd dogs without ankyloglossia.

## DISCUSSION

This work will have an important area in the literature in terms of examining the electrocardiographic data and stress behavioral parameters of Kangal shepherd dogs with ankyloglossia.

The data obtained from the resting and exercise periods in our study were found to be inside the normal range, which is similar to the data from other researches [\[10,14-17\]](#). It can be stated that having ankyloglossia did not have a pronounced effect on heart parameters during resting state as both groups did not provide significant changes in parameters. In this study, P wave amplitude and the count of heart beats per minute were significantly increased in dogs with ankyloglossia compared to the dogs without ankyloglossia during the exercise period. The duration of the PR interval, the duration of the QT interval, and T wave amplitude were significantly lower and this indicated that the workload in the heart was higher in dogs with ankyloglossia during exercise. In this case, dogs with ankyloglossia were insufficient to set the thermoregulation, thus suggesting that the workload on the heart increased. As in other studies, the increase in the number of heartbeat per minute caused the amplitude of the P wave to increase, and the duration of the PR interval and the duration of the QT interval were both shortened [\[16,18,19\]](#).

The type and intensity of exercise can cause stress in dogs [\[20-22\]](#). While conducting research for the investigation of stress behavioral parameters, there are debates on whether behavior data should be coupled with the physiological parameters. Certain researchers support that the data should be evaluated altogether [\[23\]](#); however some researchers insist that these two data would not comply with each other in case of acute stress conditions, and therefore the behavior should get the priority [\[24,25\]](#). In this study, ECG parameters and stress behavioral parameters are evaluated together. At the end of a 15-min exercise, strained lips, avoidance, yawning, lowering the body position, tail between hind legs and groovy appearance below the eyes behaviors were observed in dogs with ankyloglossia. At the end of a 15-min exercise, lowering the body position and tail between hind legs behaviors were observed in dogs without ankyloglossia.

Body position lowering and keeping tail between hind legs were reported to be associated with stress in behavioral changes for dogs as stated in recent studies [\[26,27\]](#). In a study, it was stated that dogs would have changed behaviors under stress conditions [\[28\]](#). By the notion of changed behaviors, independent activities exhibited during the behavioral incident and by the motivation is being referred [\[29\]](#). Yawning behavior was detected in dogs included to our study thus can be considered as one of the stress associated changed behavior in dogs with ankyloglossia.

In a study, it was stated that avoidance, groovy appearance below the eyes were behaviors that emerged when the animal was under stress [\[26\]](#). Similarly, in the present study, avoidance and groovy appearance below the eyes were observed in dogs with ankyloglossia. In a study, it was stated that strained lips could be observed in dogs when they were under stress [\[30\]](#). Similarly, in the current study, strained lips behavior were observed in dogs with ankyloglossia.

Ankyloglossia is a cause of increased workload on the heart during exercise in Kangal shepherd dogs and detection of all stress behavioral parameters during exercise of Kangal shepherd dogs with ankyloglossia suggest that these dogs are under stress. It is recommended that these data should be evaluated in clinical, surgical and exercise studies on dogs with ankyloglossia.

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