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Radiographic evaluation of open fontanel in puppies

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Abstract

Open fontanel is the soft membranous spot located on the head of a newborn due to incomplete fusion of the cranial bones; it is at this point that all of the skull plates finally unite. It is equivalent to the soft spot at the top of a human baby's head. An understanding of a normal fontanel and its closure pattern in puppies will help in easy identification of disorders and delay in its closure time. This study was conducted to monitor the time of closure of the open fontanel in Nigerian indigenous puppies from one week to eight weeks. A total of five apparently healthy Nigerian indigenous puppies were used for this study. Radiographic exposures of the puppies were scheduled at weekly interval for 8 weeks using a setting range of 50-60 kV and 8-10 mAs and manual processing of the films was used in this study. It was observed from the results that the average length of open fontanel in the dogs were: 1.16 mm at week one, 0.92 mm at week two, 0.91 mm at week three, 0.90 mm at week four, 0.83 mm at week five, 0.71 mm at week six, at week seven, the open fontanel of one puppy fused, with an average length of 0.40 mm for the remaining puppies, at week eight, there was complete closure of the open fontanel in all the puppies. It was observed from this study that the length of open fontanel kept reducing as the animal grew older till it finally fused.

Keywords: open fontanels, radiography, puppies, closure time

Introduction

Just like human babies, many dogs also have a "soft spot" on their heads known as an open fontanel or molera (Esmaili *et al.*, 2015) ^[3]. The open fontanel is considered normal and acceptable in some breeds (Evans, 1993) ^[4]. Open fontanel is the location on the top of the skull where all of the skull plates join. When puppies are born, the bony plates of the skull are somewhat soft and separated. As the animal grows older, this plate becomes smaller and more rigid until it gradually fuses together (Fern-King, 2019) ^[5]. Open fontanel can also be said to be a hole in the skull that result from incomplete closure in the skulls soft spots during normal growth in puppy (Couly *et al.*, 1993) ^[2]. Open fontanel has two major functions: during birth, these plates allow the skull to flex as the head passes through the birth canal; it also allows the brain to grow to its normal size after birth before they finally fuse together (Schultz, 1923) ^[11].

There is no relationship between the presence or size of an open fontanel and the presence of hydrocephalus (Fortney, 2011) ^[6]. Most open fontanel in dogs is expected to closed by 9-12 weeks although various smaller breeds of dogs, including toy and tea cups breeds, retain these holes past puppyhood. Breeds that are commonly affected with open fontanel include many toy breeds and brachycephalic breeds, such as: Chihuahuas, Pomeranians, Toy Poodles, Miniature Dachshunds, Maltese, Shih Tzus, Yorkshire Terriers, English Bulldogs, Pugs, Lhasa Apsos etc. In humans, open fontanels are of two types: the anterior and posterior fontanels (Omotade *et al.*, 1995) ^[10]. The posterior fontanel closes at 6 to 8 weeks of life whereas the anterior fontanel does not become ossified until about 16 to 18 months. This allows the skull to accommodate the tremendous growth of the infant's brain after birth. The anterior fontanel (bregma) is diamond in shape and it is found at the intersection of the sagittal and coronal sutures, it measures about 2×3 cm, and it is much larger than the posterior fontanel (Hacker and Moore's, 2010) ^[7]. The posterior fontanel is Y- or T- shaped and it is found at the junction of the sagittal and lambdoid sutures, (Hacker and Moore's, 2010) ^[7]. They are expected to harden and fuse over time in order to ensure strong protection to the brain.

Abnormality is said to occur when an open fontanel fails to fuse properly at the expected time thereby leaving a hole at that point and exposing the brain to trauma and conditions like hydrocephalus (Jin *et al.*, 2016) [8]. Diagnosis of an abnormal fontanel and a delay in its closure time in puppies requires a good knowledge of a normal fontanel size and its closure time in Nigerian Indigenous dogs. This study aims to describe the existence and the closure time of open fontanel in Nigerian Indigenous breeds of Dogs, which will help facilitate the understanding and interpretation of radiographic images of puppies' head. There is no documented information on the closure time of open fontanel in Nigerian Indigenous Dogs.

Materials and Methods

A total of five (4 males, 1 female) apparently healthy Nigerian indigenous puppies (NIP), from one litter and obtained from a local breeder was used for the present study. They were physically examined to ascertain their health status. Water was provided to the dam *ad libitum* and food was giving on a daily ration. The puppies were first taken from the dam at week one for radiographs at the veterinary radiology unit of Usmanu Danfodiyo University Sokoto, after which they were returned to the dam. Lateral view of each puppy was taken at weekly interval for 8 weeks. Each puppy was identified based on their skin color and peculiar features on their body into A, B, C, D and E. At week 1, the heads of 4 puppies were placed for lateral (figure 2) projection on a loaded cassette placed on the x-ray table for radiography without sedation from week 1-3 weeks and the weight of each puppies was taken before each radiograph. From 4 weeks to 8 weeks, xylazine hydrochloride (0.2 mg/kg) was administered intramuscularly and a setting of 50-55 Kv and 8-10 mAs was used for this study.



Fig 1: Lateral view of the heads.

The fifth puppy was exposed on a different cassette. After taking the radiographs, the cassettes were taken in to the dark room for identification and processing. The identification was done with the help of a pencil to temporarily identify the animals at one angle of the film as A, B, C, D, or E, after which it was fixed onto an adequate sized hanger before it was manually processed adopting the method described by Singh and Singh, (2001) [12]. Sellotape was used to identify each radiograph appropriately after drying. The x-ray films were viewed using an x-ray viewer and the open fontanel of each dog was measured using a Vanier caliper. Radiographic images were captured using phone camera and transferred to a computer system. Datas

obtained from this study were presented in table format for descriptive analysis.

Results

Radiography was successfully used to identify and monitor the closure of open fontanel in Nigerian Indigenous Dogs. All the dogs had one open fontanel which was identified on a lateral radiograph and this fontanel developed normally in all the dogs. No orthopedic disorder was observed during the entire experimental period. At week 1, there was incomplete closure of the open fontanel (plate 1) in all the dogs. At week 2 there was incomplete closure of the open fontanel (plate 2). At week 3 there was incomplete closure of the open fontanel (plate 3). At week 4 there was incomplete closure of the open fontanel (plate 4). At week 5 there was incomplete closure of the open fontanel (plate 5). At week 6, there was incomplete closure of the open fontanel (plate 6). At week 7, there was complete closure of the open fontanel in dog (A) but there was incomplete closure in the rest of the dogs (plate 7). At week 8, there was complete closure of the open fontanel in all the dogs (plate 8).



Plate 1: Week 1, there was incomplete closure of open fontanel.



Plate 2: Week 2-3, there is incomplete closure of the open fontanel

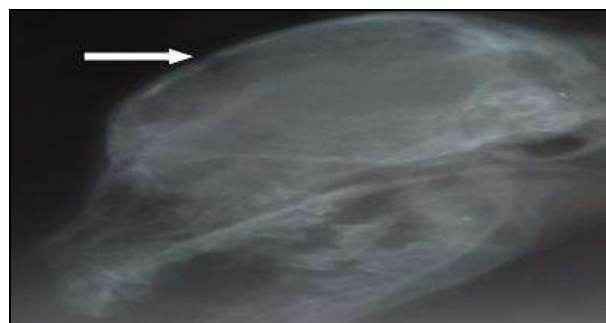


Plate 3: Week 4: incomplete closure of open fontanel in all the dogs

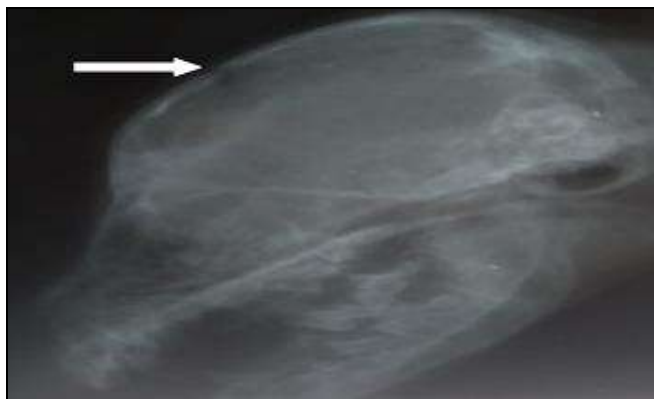


Plate 4: Week 5: incomplete closure of the open fontanel in all the dogs.



Plate 5: Week 6: there was incomplete closure of open fontanel in all the dogs.



Plate 6: Week 7: there was incomplete closure of open fontanel in all the dogs except in dog (A).



Plate 7: Week 8: complete closure of open fontanel in all dogs.

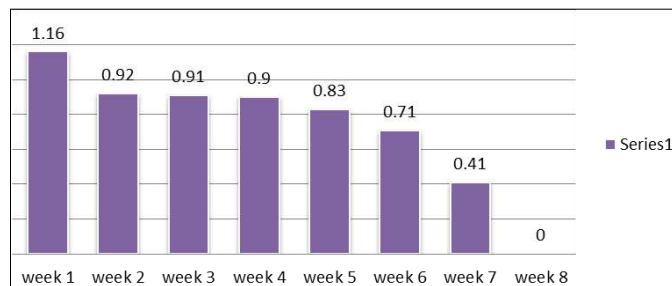


Fig 2: Showing radiographic monitoring of an open fontanel in Nigerian local breed of dog.

Discussion

From our findings, it was observed that Nigerian Indigenous Puppies had only anterior open fontanel at week one which is contrary to the work reported by Hacker and Moore's (2010) [7] who reported that humans have two open fontanels (Anterior and Posterior) and also contrary to the work reported by Kiviranta *et al.*, (2021) [9] who reported more than one fontanel in Chihuahuas. Our findings of incomplete closure of open fontanel from week 1 to 6 is similar to the work reported by Hacker and Moore's (2010) [7] in humans who reported open fontanel of posterior fontanel to be open from birth to 6 weeks and also to the work conducted by Schultz, (1923) [11] who reported an incomplete closure of open fontanel in chimpanzees. At week 7, we observed the closure of open fontanel in one dog, which may be due to nutrition or genetic variation. At week 8 there was complete closure of open fontanel in all the dogs (plate 8), which is contrary to the work reported by Hacker and Moore's (2010) [7] for anterior fontanel which closes at 18 months in humans, and is also contrary to the work reported in chimpanzees by Schultz, (1923) [11] who reported that anterior fontanel is fully closed at 3 months of age.

Conclusions

In conclusion, a single open fontanel was discovered to be present in Nigerian indigenous dogs from birth to 8 weeks of age and any time beyond 8 weeks can be associated with a problem. They were located on the dorsal, surfaces of the cranium and might not be identified by palpation alone. Radiography was successfully used to identify the open fontanel till time of closure.

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