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Original Article

Evaluation of Calvarial Bone Thickness in One-Humped Camel Fetuses

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ABSTRACT

Thicknesses of the calvarial bones of one-humped camel (*Camelus dromedarius*) fetuses were evaluated. Thirty-two samples of first, second and third trimester fetuses obtained from Sokoto municipal abattoir were used for the study. The mean thicknesses for the frontal bones are 1.30±0.02mm, 1.47±0.08mm and 1.54±0.07mm for the 1st, 2nd and 3rd trimester respectively. Parietal bones of the fetuses belonging to the 1st, 2nd and 3rd trimester had their values as 1.42±0.01mm, 1.435±0.12mm and 1.49±0.02mm respectively. Interparietal bones had mean values as 1.505±0.01mm, 2.36±0.03mm and 2.415±0.04mm at the 1st, 2nd and 3rd trimesters respectively. Occipital bones of the 1st, 2nd and 3rd trimester fetuses had their mean values as 2.36±0.08mm, 2.57±0.01mm and 4.78±0.03mm respectively, while the temporal bones of the 1st, 2nd and 3rd trimester fetuses had their values as 1.28±0.04mm, 1.85±0.27mm and 3.17±0.05mm respectively. The study showed that there were variations in the bone thickness (BT) of the calvarial bones, with the frontal and parietal bones having the least thicknesses while the occipital bone had the highest BT values, thus, this could formed a basis for the consideration of the frontal and parietal regions in situation such as stunning with captive bolt pistol in humane slaughter of camel, as these bones overlying the brain in this region appeared thinner.

Keywords: Calvaria, Thickness, Camel; fetuses.

INTRODUCTION

The calvaria (skull cap), is the vault of the neurocranium and is composed of portions of several bones. It serves to cover and protect the cerebral hemispheres of the brain. The brain is protected by meninges, which attach to the calvaria and to the brain (Ernest, 1990). The roof of the cranium (calvaria) is formed by the frontal, parietal, occipital, temporal and interparietal bones (Evans, 1993; Smuts and Bezuidenhout, 1987). However, in an adult camel the interparietal bone is not clearly visible as they have been fused to the squamous part of the occipital bone (Smuts and Bezuidenhout, 1987).

Determination of bone thickness as a predictor of mineralisation of the skeleton was first reported by Barnett and Nordin (1960). Since then, measurements of the thickness of the femoral shaft and metacarpals have been used extensively to estimate osteoporotic changes in bone (Bloom and Bloom, 1980; Bloom and Laws, 1970; Virtama and Telkkae, 1962; Morgan *et al*., 1967). The thickness of bones reflects the balance between the normal processes of bone reconstruction and destruction. The processes are affected by genetic, nutritional, breed, environmental and hormonal factors (Virtana, 1976).

This work is aimed at providing information on clinically important parameters that may aid in understanding the basis for the choice of frontal and parietal regions for stunning camel during humane slaughter process more especially using captive bolt pistol. Similarly, understanding the morphology as well as the thickness of the calvarial bones could be a good tool in understanding the need for proper restraint of this animal species and the avoidance of certain inhumane practises by farmers which may possibly cause trauma or injury to the fragile brain case overlying the delicate brain tissues more especially at the juvenile stage.

MATERIALS AND METHODS

Fetuses were collected from the metropolitant abattoir in Sokoto, Nigeria, through daily visits. The collected fetuses were cleaned and put into polythene bags and transported to the Veterinary Anatomy Laboratory of Usmanu Danfodiyo University, Sokoto, where the samples were weighed using a beam balance (Salter, No. 511, made in England), the crown-vertebral rump lengths (CVRL) measured and recorded in centimeters using a tape rule (Butterfly$^{(R)}$).

The fetuses were categorized into definite trimesters according to El-Wishy *et al.,* (1981) and decapitated at the occipito-atlantal joints.

The fetal heads were dissected using a procedure outlined by Mabbutt and Kokich, (1979). A piece (1 cm^2) of each calvarial bones were obtained and the thicknesses measured (i.e. for the frontal, parietal, interparietal, occipital and temporal bones respectively) using a vernier caliper and recorded in millimeters.

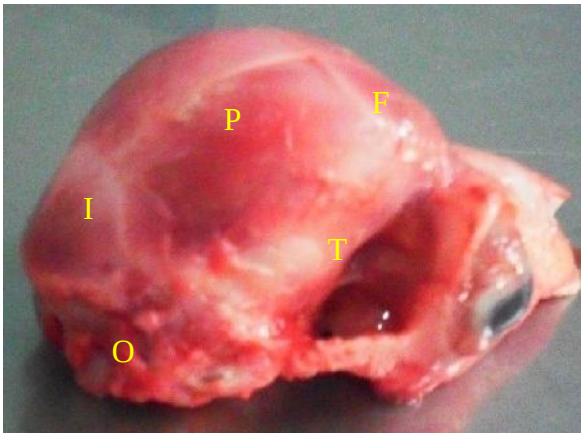

Plate 1: A caudolateral view of a camel fetal skull showing where cavarial bone specimens were taken for measurements (Magnification ×125)
F = Frontal bone, **P** = Parietal bone, **I** =Interparietal bone, **T** = Temporal bone, **O** = Occipital bone

RESULTS

The results of the measurements of bone thicknesses as shown had the mean thicknesses for the frontal bones as 1.30±0.018mm, 1.47±0.075mm and 1.54±0.074mm corresponding to the first, second and third trimesters respectively. Parietal bones of the fetuses belonging to the first, second and third trimester had their mean corresponding values of 1.42±0.004mm, 1.43±0.12mm and 1.49±0.016mm, respectively. Interparietal bones had average values of 1.50±0.002mm, 2.36±0.034mm and 2.41±0.040mm, corresponding to the first, second and third trimesters, respectively. Occipital bones of the first, second and third trimester fetuses had average values of 2.36±0.080mm, 2.57±0.011mm and 4.78±0.031mm, respectively, while the temporal bones of the first, second and third trimester fetuses had average values of 1.28±0.040mm, 1.85±0.267mm and 3.17±0.047mm, respectively (Table 1).

DISCUSSION

Bone developments, chemical and physical properties of bone are affected by age, nutrition, hormonal status and diseases (Loveridge, 1999). Bone serves as a metabolic reservoir for calcium, phosphate and other minerals, and it houses cells responsible for bone formation and resorption. The findings from the bone thickness (BT) analysis revealed that individual calvarial bones had different bone thicknesses rhyming

with each change in gestational ages. It showed that frontal and parietal bones, though having variable thicknesses, had the least bone thicknesses at each trimester when compared to other calvarial bone types at all the trimester levels. In the same vein, the occipital bone had the highest values of BT at all the trimesters when compared to other bones.

Table 1: Mean Bone Thickness (BT) of the Calvarial Bones for the 1st, 2nd and 3rd Trimester Fetuses (± SEM)

Bone Type	BT (mm) for 1st Trimester (n = 11)	BT (mm) for 2nd Trimester (n = 12)	BT (mm) for 3rd Trimester (n = 9)
Frontal	1.30 ±0.018	1.47 ±0.075	1.54 ±0.074
Parietal	1.42 ±0.004	1.43 ±0.012	1.49 ±0.016
Interparietal	1.50 ±0.002	2.36 ±0.034	2.41 ±0.040
Occipital	2.36 ±0.080	2.57 ±0.011	4.78 ±0.031
Temporal	1.28 ±0.040	1.85 ±0.267	3.17 ±0.047

($P<0.05$)

Determination of bone thickness is a predictor of mineralisation of the skeleton and is found to show a significant increase with age (De-Schepper, *et al*., 1996; Barnett and Nordin, 1960), these findings were consistent with the findings in this present research. It was also revealed in this study that calvarial bone thicknesses increased significantly ($P<0.05$) with gestational ages, this is found to be consistent with the works of Angel (1971); Ross *et al*., (1998); Roche (1953); Israel (1973).

From the results of this study, it could be deduced that the variations in the thicknesses of the calvarial bones with the frontal and parietal bones having the least thickness could form a basis for the consideration of the frontal/parietal region in a situation such as stunning by captive bolt pistol in humane slaughter of matured camel, as these bones overlying the brain in this region appeared thinner. Also, understanding the morphology as well as the thickness of the calvarium could be a good tool in understanding the need for proper restraint of this animal species and the avoidance of certain inhumane practises by farmers and animal handlers which may possibly cause trauma to the fragile brain case overlying the delicate brain tissues more especially at the juvenile stage.

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