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Quantitative and Comparative Analysis of the Torg-Pavlov Ratio: A comprehensive Cadaveric Study of the cervical segment of the spine in Nigeria.

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ABSTRACT

The canal body ration measured using the anteroposterior aspect of the vertebral body and the anteroposterior aspect of the vertebral canal is known as the 'Torg-Pavlov ratio' and can be used as a fairly accurate diagnostic tool for vertebral stenosis. Measurements were taken on 188 cervical vertebrae which comprised males and females ranging from C2 to C7. The aim of this study was to measure linear dimensions of vertebral body and neural arch elements by regions, determine pattern and degree of relationships and also evaluate its canal to body ratio so as to provide population specific data for Nigerians. Mean values for C2 was 0.75±0.14mm for male and 0.70±0.05mm for females, C3 was 0.80±0.16mm for male and 0.74±0.14mm for female, C4 was 0.81±0.18mm for male and 0.69±0.03mm for female, C5 was 0.80±0.15mm for male and 0.65±0.03mm for female, C6 was 0.82±0.17mm for male and 0.69±0.04mm for female and C7, 0.81±0.13mm for male and 0.76±0.11mm for female. These data will improve current of the understanding of morphological parameters of cervical spine region of Nigerian population. It will also be important in designing spinal implants which would be biomechanically compatible to Nigerians.

Keywords: Cervical vertebrae, Nigerian, spinal canal, Torg-Pavlov ratio.

INTRODUCTION

Nigeria has recently joined the global medical community in the search for new frontiers to effectively manage problems related to human spine, particularly where surgical interventions are indicated [1,2]. Clinical disorders of the spine are on the increase globally, and in Nigeria, majority of them commonly involve disruption in the anatomical configuration. They can be classified as congenital and acquired. Majority of the congenital conditions are complex and may be mild without any symptoms, and undetected until puberty or early adulthood. They can also be severe with rapid progression to life threatening complications. In Africa, preferences for traditional medicine are responsible in part for the high morbidity and mortality reported in developing countries [1].

Precision surgery often with instrumentation remains the last lifesaving and maintenance option when all others fail. However, surgical management of spine disorders in Nigeria is at the early stage and at the moment, the outcomes in some cases are sometimes substantially more devastating than the presenting problems[1].

For better understanding of spine anatomy with regards to patient information, continuous medical surgical education and most especially, the design of specific biomaterials for replacement therapies, there is need for country specific quantitative anthropometric research with a focus on detailed anatomical dimensions of those components of the skeleton of the spine directly involved in biomechanics and other related factors. Results from such studies will address the challenges currently facing this aspect of health care by providing the much needed data for pre, intra and post-operative management of spine related problems.

The size of the cervical vertebral canal has clinical relevance in trauma and degenerative conditions of the spine [3]. It has been shown that greater canal diameters reduce the probability of neurological damage secondary to fractures or dislocation of the cervical spine [4].

[6] Pavlov et al, proposed a method for detecting cervical stenosis called the "Torg-Pavlov ratio" [5,6]. This ratio is obtained by dividing the AP diameter of the cervical canal by the AP diameter of the vertebral body. A result equal or less than 0.80 is accepted as an indicator of significant cervical stenosis [3,7-10] and a ratio greater than or equal to 1.00 indicates no canal stenosis [10].

MATERIALS AND METHODS

This study was a cross sectional survey in which cadavers obtained from the mortuary units, department of anatomy, University of Port Harcourt and that of

PAMO University of medical sciences.

For this study, 188 individual cervical vertebral bones from 37 cadavers were used. The bones were prepared by soil and water maceration. We avoided use of chemicals, bleaching and polishing that may result in loss of tissue from the end plates and disc. They were all free from deformities, evidence of trauma, fractures, osteoporosis.
Measurements were taken directly on the bones using a digital Vernier calliper with precision 0.01mm. The following measurements were taken;

Vertebral body- is the distance between the anterior border and the posterior border of the vertebral body at the midline on the upper surface of the vertebra. (Figure 1a).

Vertebral canal APD/ Canal body height - is the distance between the posterior border of the vertebral body and the posterior border of the spinal canal at the level of the midline i.e. junction between two vertebrae laminae (Figure 1b). The Torg-Pavlov ratio was digitally calculated by dividing the canal AP diameter by the vertebral body AP diameter. Data collected from this study was subjected to statistical analysis IBM SPSS statistics for windows, version 23.0 Armonk, NY:IBM corp. Results were analysed for Descriptive statistics and Pearson Correlation.

Ethical Consideration: The Research Ethics Committee of the University of Port Harcourt approved this study with reference number; UPH/CEREMAD/REC/MM84/045

RESULTS
The cervical vertebrae bodies of C2 - C7 were studied with their spinal canals. The mean values obtained for the vertebral body were C2=15.76±2.38mm for male and 15.35±1.90mm for female, C3=16.87±2.12mm for male and 17.49±1.44mm for female, C4=17.30±1.95mm for male and 16.78±1.05mm for female, C5= 16.56±1.74mm for male and 17.25±0.50mm for female C6= 16.99±2.09mm for male and 17.91±0.83mm for female, C7=17.68±2.31mm for male and 18.30±1.17mm for female (table 1).

Table 1: descriptive statistics for vertebral body (mm)

	MALE		FEMALE	
VERTEBRA LEVEL	Mean	SD	Mean	SD
C2	15.76	2.38	15.35	1.90
C3	16.87	2.12	17.49	1.44
C4	17.30	1.95	16.78	1.05
C5	16.56	1.74	17.25	0.50
C 6	16.99	2.09	17.91	0.83
C7	17.68	2.31	18.30	1.17

Table 2: descriptive statistics for vertebral canal/canal body height (mm)

	MALE		FEMALE	
VERTEBRA LEVEL	Mean	SD	Mean	SD
C2	11.69	1.68	10.70	1.63
C3	13.44	2.80	12.98	2.31
C4	13.92	2.87	11.51	0.68
C5	13.11	2.11	11.28	0.75
C6	13.72	0.41	12.38	1.32
C7	14.09	1.73	13.81	1.93

Table 3: descriptive statistics for Torg-Pavlov ratio (mm)

	MALE		FEMALE	
VERTEBRA LEVEL	Mean	SD	Mean	SD
C2	0.75	0.14	0.70	0.05
C3	0.80	0.16	0.74	0.14
C4	0.81	0.18	0.69	0.03
C 5	0.80	0.15	0.65	0.03
C6	0.82	0.17	0.69	0.04
C7	0.81	0.13	0.76	0.11

Figure 1a: Boundaries of the vertebra body

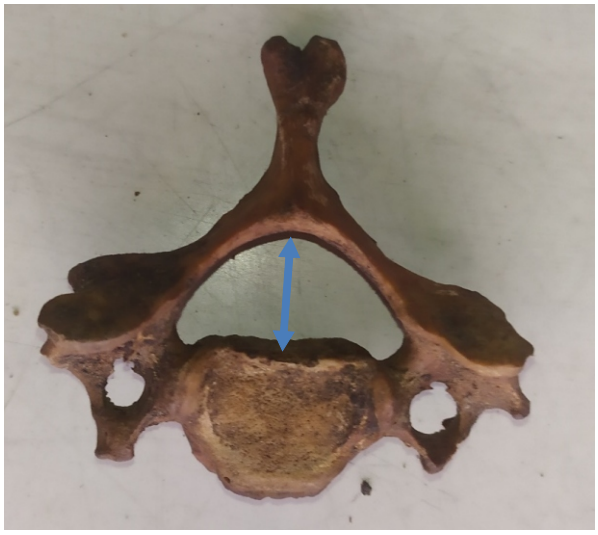

Figure 1b. showing the boundaries of the vertebra canal /canal body height

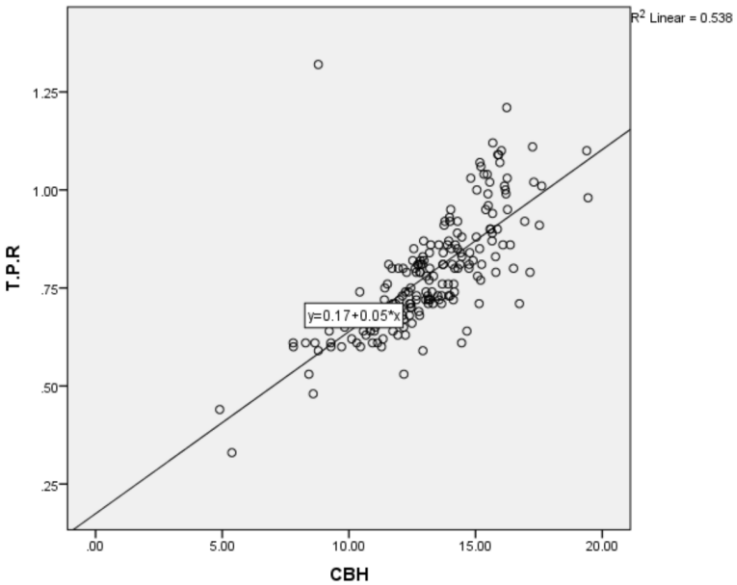

Figure 2: Pearson correlation of T.P.R and CBH, T.P.R can be estimated from CBH using y=0.17+0.05*x where y= T.P.R and x=CBH.

Vertebra canal measurements were given as C2=11.69±1.68mm for male and 10.70±1.63mm for female, C3=13.44±2.80mm for male and 12.98±2.31mm for female, C4=13.92±2.87mm for male and 11.51±0.68mm for female, C5= 13.11±2.11mm for male and 11.28±0.75mm for female, C6=13.72±2.25mm for male and 12.38±1.32mm for female, C7=14.09±1.73mm for male and 13.81±1.93mm for female (table 2).

Mean values for the canal to body ratio for C2=0.75±0.14mm for male and 0.70±0.05mm for females, C3=0.80±0.16mm for male and 0.74±0.14mm for female, C4=0.81±0.18mm for male and 0.69±0.03mm for female, C5=0.80±0.15mm for male and 0.65±0.03mm for female, C6=0.82±0.17mm for male and 0.69±0.04mm for female and C7=0.81±0.13mm for male and 0.76±0.11mm for female (table 3).
Figure 1: shows pearson correlation of Torg-Pavlov ratio and canal body height. It was also observed that there was a strong positive correlation between Torg-Pavlov ratio and canal body height ($p>0.05$).

DISCUSSION

The Torg-Pavlov ratio is used for the diagnosis of cervical canal stenosis. The canal dimension is given that an individual with a ratio less than 0.8 is believed to be stenotic [6] and it is a significant risk factor of neurological injury which eventually gives off a narrow canal.

The mean values of the vertebra body for male were higher than that of the female only at C2 and C4 (15.76±2.38mm for male and 15.35±1.90mm for female and 17.30±1.95mm for male and 16.78±1.05mm for female respectively). The highest values were recorded at C7 (17.68±2.31mm for male and 18.30±1.17mm for female) with the lowest being at C2 (15.76±2.38mm for male and 15.35±1.90mm for female).

The mean values of the vertebral canal were higher in male than it is in females across C2 – C7. Although, they were no distinct pattern as to how these measurements followed, the highest measurements recorded for males and females was at C7(14.09±1.73mm for male and 13.81±1.93mm for female) with the lowest being C2 (C2=11.69±1.68mm for male and 10.70±1.63mm for female).

The Torg-Pavlov ratio was about the same for men for C3 to C7 which was similar with [11-13] but was in contrast with [14] who recorded higher values.

Other authors [15,16] recorded a higher Torg-Pavlov ratio in female than in male which was in contrast with this study, although similar to this study, Udoaka and Ewulike [14] reported higher values of the Torg-Pavlov in males.

CONCLUSION

We found in this study, values of Torg-Pavlov ratio for the sub-axial cervical spine, which were comparable with those obtained from previous studies with similarities and differences. The differences could be due to race and design of experiment among others. Male and female cervical spines had similar dimensions
Population and group specific data such as these will be helpful in the surgical management of patients

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