Pelvimetry among normal, healthy females using three-dimensional computed tomography in Sohag population: A retrospective Morphometric study regarding age

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Abstract

Background: Measurements of the pelvic planes become essential to be described nowadays, so that obstetricians become able to describe and diagnose cases of a narrow pelvis and decide a cesarean section correctly, comparison of these parameters with other populations is very important as well as associate any changes with age.

Objectives: is to evaluate the pelvic inlet and outlet parameters among normal, healthy non-pregnant reproductive-aged females and compare between younger and older ones in Sohag Government.

Patients and Methods: The study was done on the archived information of Departments of Diagnostic Radiology, Sohag Faculty of Medicine, Sohag University, in Upper Egypt on 110 female patients from 18 to 55 years old who underwent computed tomography (CT) between March 2022 to March 2023 and was grouped into younger and older according to age. Four measurements was taken on sagittal plane Anatomical conjugate diameter (ACD); Obstetric conjugate diameter (OCD); Diagonal conjugate diameter (DCD) and Anatomical anteroposterior diameter of the pelvic outlet (AD) plus the Bituberous diameter (BD) on the coronal plane.

Results The mean Anatomical conjugate diameter (ACD) was 11.4 ±1.03 cm, Obstetric conjugate diameter (OCD) was 10.9±1.06 cm, Diagonal conjugate diameter (DCD) was 12.4± .9 cm, Anatomical anteroposterior diameter of the pelvic outlet (AD) was 9.67 ±1.25 cm, Bituberous diameter (BD) was 10.74±.89 cm

Non-significant changes appeared between the two age groups as regards the five measured parameters.

Conclusion: No-significant differences was found between younger and older females as regarding inlet and outlet pelvic parameters

Keywords: Pelvimetry; Computed tomography; Pelvic cavity.

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Introduction

Pelvimetry is a word formed of two parts; pelvi- a Latin word pelvis (means basin) and metron which is a Greek word means measure. So, the pelvimetry is to measuring the pelvis, which may be established by many methods: manually, using instrument (by a caliper), and radiographically **(Yeomans, 2006).**

Most caesarean operations appear due to cephalopelvic disproportion especially that detected during the first delivery. (**Gabbe et al., 2017)**, so it is important to determine measurments of the pelvis before birth which evaluate the prognosis **(Munabi et al., 2016)**.

In most conditions, manual pelvimetry is not accurately to measure pelvic diameters, specially the inlet, so, radiographic pelvimetry was widely used and was improved to prevent risks related to these cases **(Vázquez-barragán et al., 2016)**. Many facilities are used, as x-ray, pelvic computed tomography (CT), and magnetic resonance imaging (MRI) **(Harper et al., 2013)**. CT is the suitable choice nowadays **(Sule & Matawal, 2005),** because it provides a better estimation of the pelvic diameters of inlet (**Chan Ben & Lao Terence,2009). Rozenholc et al., (2007**) showed that the three dimensional (3D) measurements by using reconstructed images from computed tomography are not affected by the projection plane, rotation, and/or lateral tilt of the pelvis and not affected by soft tissue artifacts **(Hambidge et al., 2018).**

The aim of this work was to evaluate pelvic anatomical measurements using a 3D measurement obtained by CT between normal, healthy females with comparison between younger and older ones.

Patients and methods

A retrospective, anatomical descriptive study carried out in Anatomy and Radiology Departments in Sohag Faculty of Medicine, Sohag University, Upper Egypt, from 1st March 2022 to 1st March 2023. This study included 110 normal healthy adult non -pregnant females from Sohag governorate (≥18 & ≤ 55years).

Ethical considerations: This study was ethically approved in Scientific Research Ethics Committee Sohag University (Sohag Faculty of Medicine Ethical Committee under IRB registration number:Soh-Med-23-03-11PD) and followed items of declaration of Helsinki written consent were waived due to the retrospective design of the study. However, personal information from the participants were anonymize before analysis.

Inclusion criteria: Sohag adults aged 18 or older free from any illnesses interfere with pelvic measurements and with enough imaging data for assessment.

Exclusion criteria: younger than 18 years, older than 55 years, non-Sohag population and incomplete imaging data.

Patient's classification

Two equal groups were generated: (1) Females 18-34 years old, (2) Females 35-55 years old.(**Mirgalobayat et al. 2019),** In each group, available cases were screened for inclusion/exclusion criteria until 55 CT scans were included per each group.

Procedures

CT scans were performed using a 16 slice CT scanner (Activation, Toshiba Medical, Tokyo, Japan). .

Data was stored in a picture archiving and communication system (PACS), and the relevant PACS client was used to evaluate it.

The data was analyzed by using VITREA software, version 5.2.497.5523

For accurate visualization of images a multiplanar reformatting program was used (Volume Rendering) for making a reconstruction of the bone with focus primarily from the T12/L1 level

to the neck of the femur, establishing a plane thickness of 0.625 mm.

Planes and reconstructions for measurements

All parameters were done by a single observer who was blinded to all clinical information.

For suitable measurements centralization of the CT were done **(Fig. 1)**, volume-rendered images were evaluated in a way that implies measurements in standard cranial, posterior and lateral views.

Fig.1. An Image of pelvic 3D reconstruction of CT scan showing patient CT centralization in different planes.

Then the data set was cut in midsagittal direction, and sagittal measurements were obtained on a strict lateral view for the following four anteroposterior pelvic parameters, were measured **(Mirgalobayat et al., 2019; Mutluay & Demir, 2020)**:

Anatomical conjugate diameter or true conjugate (ACD): Anteroposterior diameter of the pelvic inlet, it is represented by a line from the pubic symphysis upper border to the sacral promontory tip (**Fig. 2**).

Obstetric conjugate diameter (OCD): It is the shortest antero-posterior diameter, from sacral promontory tip to the most prominent part in the back of symphysis pubis (1 cm below the upper border) (**Fig. 3**).

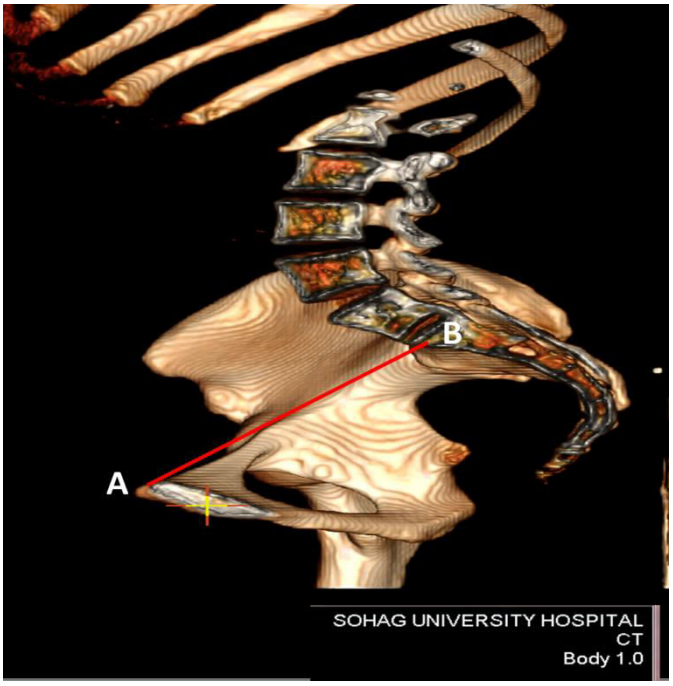

Fig. 2. An Image of pelvic 3D volume rendered reconstruction of CT scan; anatomical conjugate diameter extending between symphysis pubis upper border **(A)** and the sacral promontory tip **(B)** .

Fig. 3. An Image of pelvic 3D volume rendered reconstruction of CT scan; obstetric conjugate diameter extending between bulging point of the back of symphysis pubis **(A)** and the tip of sacral promontory **(B)**

Diagonal conjugate diameter (DCD): it is the Anteroposterior diameter of the pelvic inlet represented by a line from sacral promontory tip to symphysis pubis lower border (**Fig. 4**).

Anatomical anteroposterior diameter of the pelvic outlet (AD): A line from tip of coccyx to symphysis pubis lower border (**Fig. 5**).

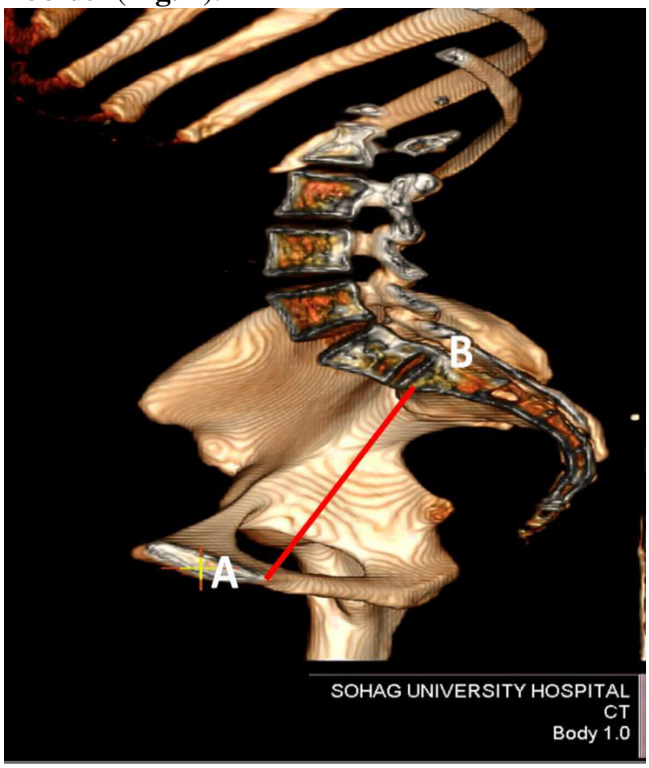

Fig.4. An Image of pelvic 3D volume rendered reconstruction of CT scan; obstetric conjugate diameter extending between symphysis pubis lower border **(A)** and sacral promontory tip **(B)**

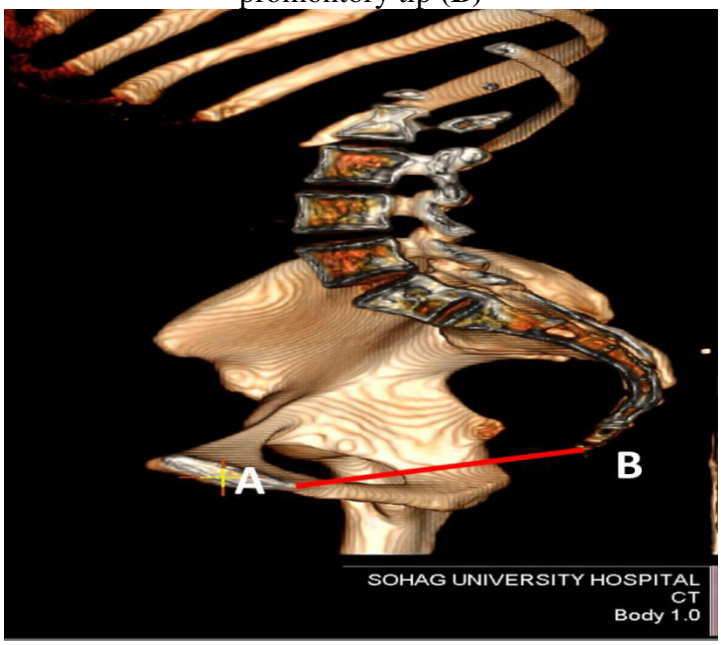

Fig.5. An Image of pelvic 3D volume rendered reconstruction of CT scan; obstetric conjugate diameter extending between lower border of symphysis pubis **(A)** and the tip of coccyx.

The posterior view was used to show the ischial tuberosities clearly to measure the intertuberous (Bituberous) diameter. Bituberous diameter (BD): The transverse diameters of the pelvic outlet it is represented by a line between the widest distances between the ischial tuberosities (**Fig. 6**). All parameters (in cm) were stored and analyzed statically.

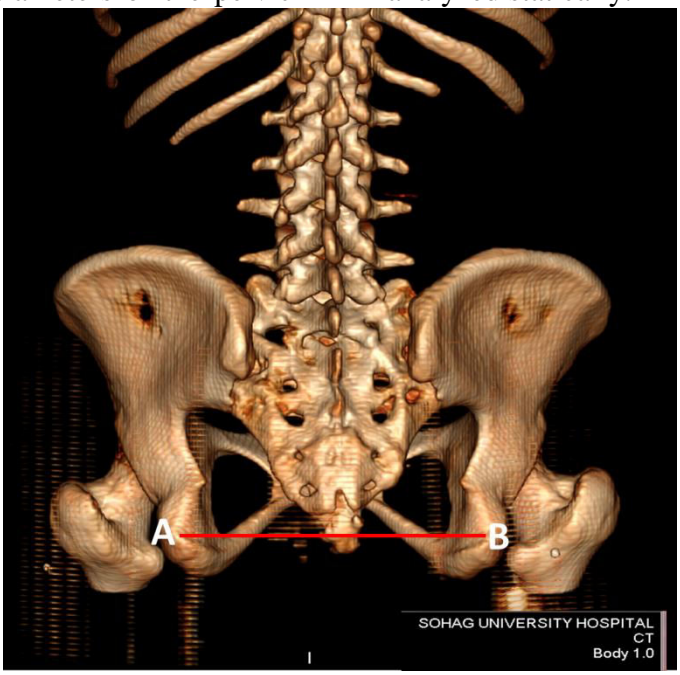

Fig. 6. An Image of pelvic 3D volume rendered reconstruction of CT scan; Bituberous . Diameter extending between both ischial tuberosities (**A)** and **(B)**

Statistical Analysis

SPSS software, version13.0 (SPSS Inc., Chicago, IL) were used. Variables presented by mean ± standard deviation (SD). The independent T-test used to compare between different groups, and a $p<0.05$ considered significant.

Results

The mean Anatomical conjugate diameter (ACD) was 11.4 ±1.03 cm, Obstetric conjugate diameter (OCD) was 10.9±1.06 cm, Diagonal conjugate diameter (DCD) was 12.4± .9 cm, Anatomical anteroposterior diameter of the pelvic outlet (AD) was 9.67 ±1.25 cm, Bituberous diameter (BD) was 10.74±.89 cm **(Table. 1)**.

Table 1: Morphometric results of the different measured parameters (Mean ±Standard deviation)

Measurement	ACD	OCD	DCD	AD	BD
Mean± SD(cm)	11.4 ±1.03	10.9 ±1.06	12.4± .9	9.67 ±1.25	10.74±.89

The mean Anatomical conjugate diameter (ACD) in group 1 was (**11.54 ±0.97**) and in group 2 (**11.27 ± 1**), measurements showed non-significant differences between younger and older groups as the P value was (> 0.3)**, (Table .2) and (Fig. 7).**

Table 2: Measurements of pelvic planes of both groups in cm (Mean ± SD)

Groups	ACD	OCD	DCD	AD	BD
1(n=55)	11.54 ±0.97	11.06±1.15	12.48±1.1	9.63±1.3	10.81±.56
2(n =55)	11.27 ± 1	10.91±.99	12.37±.86	9.72±1.1	10.68±1.1

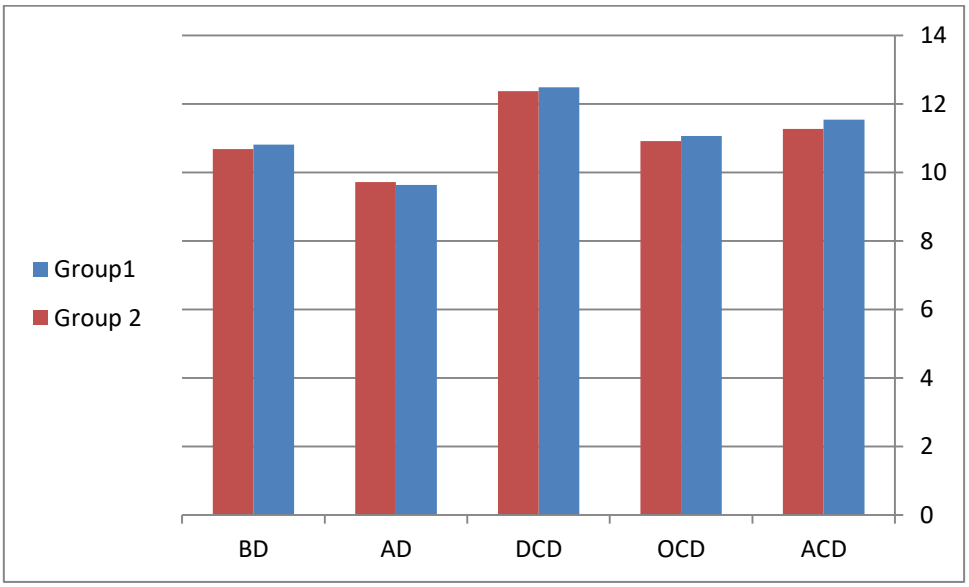

Fig. 7. Measurements of pelvic planes of both groups (in cm)

The mean Obstetric conjugate diameter (OCD) in group 1 was (11.06±1.15) and in group 2 (10.91±.99), with a non-significant differences between the two groups as the P value was (>0.5), **(Table .2) and (Fig. 7).**

The mean Diagonal conjugate diameter (DCD) in group 1 was (12.48±1.1) and in group 2 (12.37±.86), with a non-significant differences between the two groups as the P value was (>0.6) **(Table .2) and (Fig. 7).**

The mean Anatomical anteroposterior diameter of the pelvic outlet (AD) in group 1 was (9.63±1.3) and in group 2 (9.72±1.1), with a non-significant differences between the two groups as the P value was **(>0.7), (Table .2) and (Fig. 7).**

The mean Bituberous diameter (BD) in group 1 was (10.81±.56) and in group 2 (10.68±1.1), with a non-significant differences between the two groups as the P value was (>0.5), **(Table .2) and (Fig. 7).**

Discussion

Regarding to studies based on anatomy and anthropology pelvimetry seems to have a main role in estimation of the bony pelvic diameters **(Aubry et al., 2018).**

Lenhard et al. (2009) indicate that 3D volume-rendered reconstructions is a simple and accurate method in determination of pelvimetric dimensions and therefore may be considered as the method of choice.

There are a previous few studies that analyze normal pelvic

diameters in the normal females, most of these are established during labor **(Spörri et al., 1997; Spörri et al., 2002; Huerta-Enochian et al., 2006; Korhonen et al., 2010 Daghighi et al., 2013; Harper et al., 2013)** few studies focused on the changes of these measurement with age **(Vázquez-barragán et al., 2016).**

In this study, results of pelvimetry using 3D volume-rendered CT in normal nonpregnant females were evaluated; pelvic parameters (ACD, OCD, DCD AD **&**BD) were measured as these are the essential measurements of evaluation of cephalopelvic disproportion.

The main Anatomical conjugate diameter (ACD) in this study was 11.4 ±1.03cm. A previous study in Egypt in 2017 **(Mostafa et al., 2017)** studied 47 females above 18 and found the mean ACD about 11.9.8±2.9 **Korhonen et al. in 2010** showed that the ACD in 100 pregnant women by MRI was between 11.8 cm and 12 cm. A previous study **of Mirgalobayat et al., 2019** in Iran studied 157 subjects and had a true conjugate (12.2.0 ± 9.0 cm)

Concerning Obstetric conjugate diameter (OCD) in this study its mean was 10.9±1.06. **Mirgalobayat et al., in 2019** studied 157 non reproductive-aged women In Iran found OCD 11.8.2 cm**. Vázquez-Barragán in 2016** found in Mexico, the mean OCD 11.73±0.98. **Lenhard et al. in 2010** studied 36 non-pregnant in Germany and found OCD about 12.0±0.9. **Spörri**, **et al. in 2002** in **Switzerland** studied 48 pregnant females and found the mean OCD about 11.9±0.9.

Concerning the Diagonal conjugate diameter (DCD) in this study the mean was 12.4± .9 cm. **Mirgalobayat et al.,** in 2019 in Iran found DCD about 12.3.9 ± 9.5 cm

Concerning the Anatomical anteroposterior diameter of the pelvic outlet (AD) in this study was 9.67 ±1.25. **Mostafa et al., 2017** in Egypt in studied 47 females above 18 and found the mean AD 10.6.5±5 while **Lenhard et al. in 2010** in Germany found AD larger about 12.0 ± 0.2 cm.

Concerning the Bituberous diameter (BD) in this study was 10.74±.89 cm. **Mostafa et al., 2017** in Egypt in it was about 11.4.6±2.2, while **Lalèyè et al., 2018** in Bénin (Africa) found it was in mean of 12.88 ±1cm**, also** in **Lenhard et al., 2009** in Germany showed that the BD was about 12.2 ± 0.4cm.

In this study No-significant differences was found between younger and older females as regarding inlet and outlet pelvic parameters on the other hand **Vázquez-Barragán in 2016** in Mexico described that measurements of the pelvis decrease in older females ; females above 40 years showed a significant smaller pelvic diameters in comparison with younger women. Also **Mirgalobayat** in 2019 in Iran described that the inlet and midpelvis diameters of women under 35 years old are significantly decreased in compared to those above 35 years old, with rate of the cesarean section more in women above 35 years old.

Conclusion

In Sohag there was non-significant differences between females<35 and females >35 years old as regards pelvic inlet and outlet parameters.

Recommendations

This study was established on small sample size and from one region (Sohag region). It is recommended to establish similar studies upon a greater sector of the Egyptians and from different regions in Egypt.

Conflict of interest: None

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