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Sex Determination through Acetabular Standards on Western up Population Using CT scan

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ABSTRACT

Objective: Acetabular morphology differs by geographic location. This study reveals an analysis of the Northern Indian population's native acetabulum using coronal, sagittal, and axial metrics based on CT.

Hypothesis: Sex estimation in north Indians is accurate with acetabular measures.

Material Method: NCCT pelvis of 132 patients (73 female and 59 male) were done in the Department of Radiological and Imaging Techniques, Teerthanker Mahaveer University, Moradabad. Acetabular diameter (AD), Transverse acetabular diameter (TAD), Cotylopubic length (CP length), Acetabulum-pubis index (A-P index), and Length from ischial tuberosity to acetabulum rim were measured. The study comprised fully ossified human hip bones free of morphological and pathological flaws. A-P index was calculated by using formula: AD × 100 / CP length

Results: The study included 59 males and 73 females, with a mean age of 41.1±15.3 years (20–80 years). In this study, females had a significantly higher CP length ($p<0.001$). AD and AP index were significantly larger in males when compared to females.

Index Terms: Acetabulum, Computed Tomography, North Indians, Gender determination

INTRODUCTION

The broad, uneven, flattened hip bone is narrowed in the centre and enlarged above and below. They come together to form the pelvic cavity's anterior wall and sidewalls. It crosses paths with its opposite on the opposite side in front of the centre line. The pubis, ischium, and ilium are distinct anatomical features in a young person, but they fuse together in an adult. In the middle of the bone's outer surface is a big cup-shaped articular cavity called the acetabulum, which is where the three parts meet.(1)

Adult skeletal remains can yield a biological profile with approximately 90% accuracy. (7) The acetabulum is a unique anatomical structure that can withstand physical exercise, obesity, damage, and post-mortem alterations. (8) Using a computed tomography (CT) scan, multiplanar evaluation may determine acetabular depth, version, and inclination simultaneously, which is a previously unknown method in the Indian population. (9)

The key to evaluating all of these parameters simultaneously is multiplanar evaluation using a computed tomography (CT) scan. Using coronal, sagittal, and axial characteristics derived from CT, we offer an anthropometric analysis of the native acetabulum in the population of Northern India.

This study's objective is to use multi-slice computed tomography to evaluate the acetabulum's sexual dichotomy employing standard metrics in a population sample from the UP West.

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MATERIALS AND METHODS

Cochran's method was used to determine the sample size, taking into account a 95% confidence level, a 5% margin of error, and a 50% population percentage. A sample size of 132 was found to be adequate for this investigation based on this computation.

The sample size is small but it is similar to other research in this area. (Sreenivasan and Ahmed, 2021 [5], Paul *et al.*, 2020 [9], Gwala *et al.*, 2020 [10], Sachdeva *et al.*, 2019 [13], Botha *et al.*, 2015 [18], Siddapur and Siddapur, 2014 [20] and Macaluso, 2010 [22]

Inclusive criteria

i. Patients of either gender with age ranging between 20- 80 years.
ii. Patient's coming for CT-pelvis study.
iii. Individuals from all socioeconomic categories.
iv. Only complete, undamaged acetabula were measured.

Exclusive criteria

i. Damaged acetabulum.
ii. Pelvic injuries.
iii. Previous history of acetabular fractures.
iv. Underlying pathology of bones such as tumor etc.

For assessment, these individuals underwent computed tomography without contrast (NCCT) examinations of their respective right hips, which had been done for a few different reasons. We evaluated 132 radiographs that revealed no abnormalities in the hip joint bones. Individuals with a history of acetabular fractures, pelvic injuries, underlying bone pathology, including tumors, or previous acetabulum damage were excluded.

The average age of the 59 men and 73 women participants in the study was 41.1±15.3 years (20–80 years). Data for the study came from patients who were referred to the imaging OPD/IPD unit at Teerthanker Mahaveer Hospital. Five factors were measured using different CT scan viewpoints. When the patient was supine for the CT scan, the thigh, knee joint, and foot were all in a properly aligned position. We used a multislice CT scanner (Philips Ingenuity Core 128 slices) with cuts that were 1 mm thick. To evaluate the data, RadiAnt DICOM Viewer 2024.1 was utilized. Informed consent was given by each patient.

The parameters evaluated were: 1. Acetabular diameter (AD) which is the maximum acetabulum diameter measured from superior to inferior; along the ischium's body axis. (12) (Fig.1).

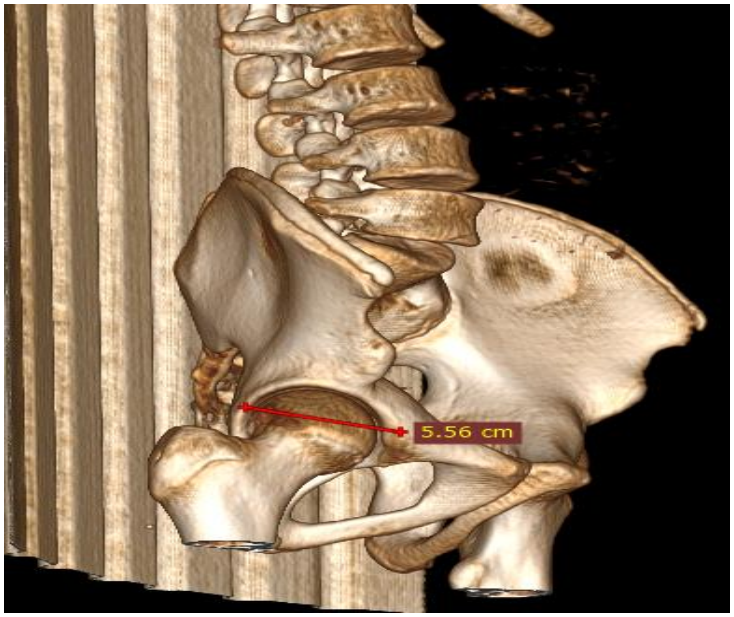

Figure.1. Figure showing measurement of acetabular diameter.

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2. Transverse acetabular diameter (TAD) which is the maximum diameter of acetabulum measured from the acetabular rim's pubic prominence. (12) (Fig.2)

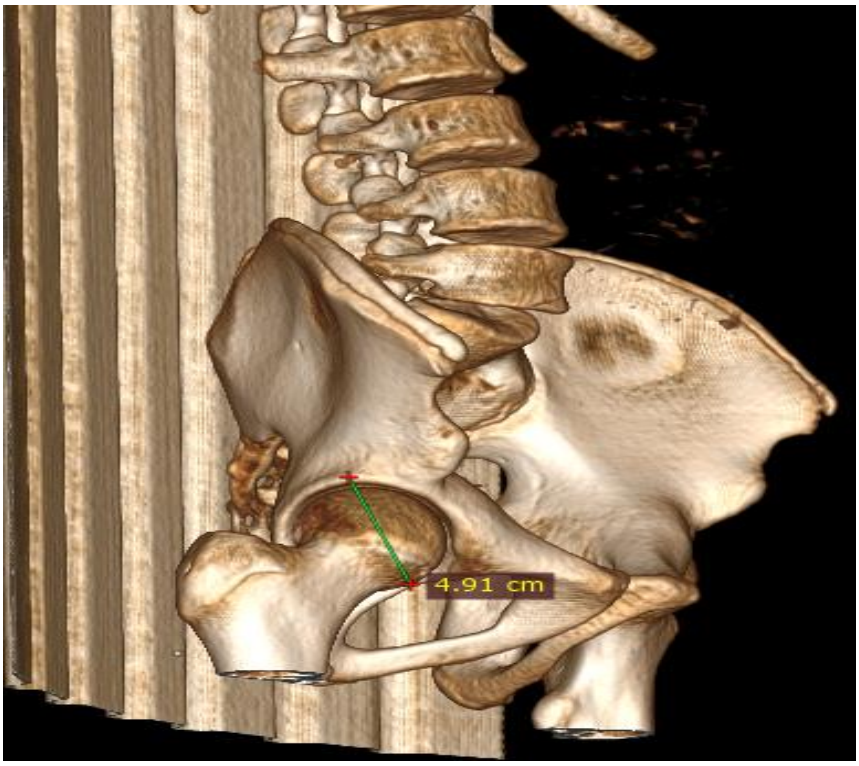

Figure.2. Figure showing measurement of transverse acetabular diameter.

3. CP length which was estimated as the gap between the front rim of the acetabulum and the pubis symphysis. (5) (Fig.3)

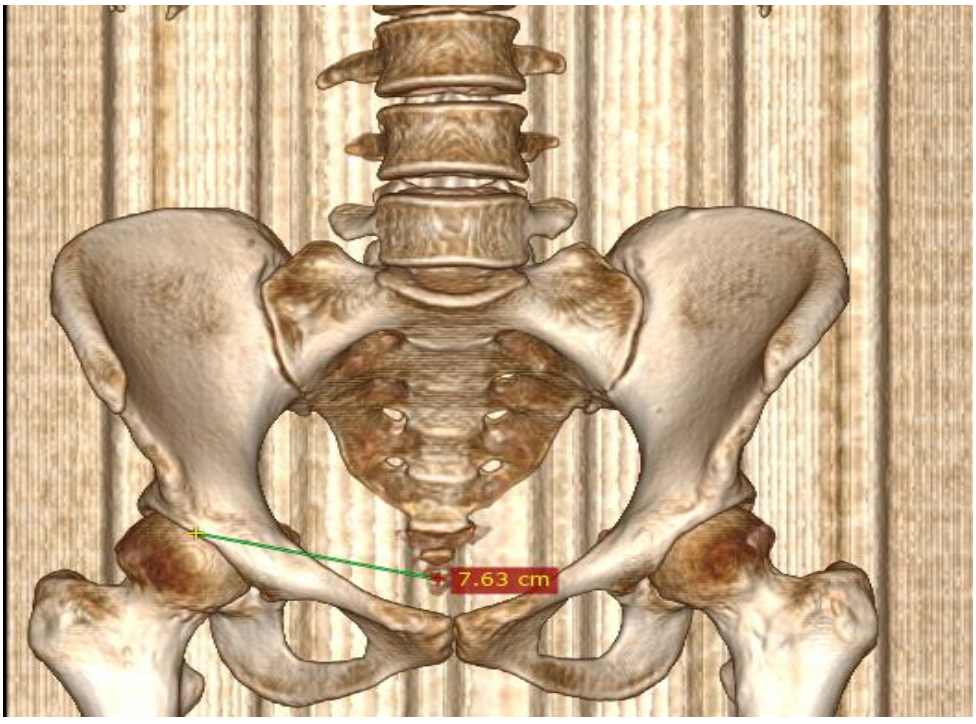

Figure.3. Figure showing measurement of CP length.

4. A-P index which was calculated using the formula AD × 100 / PS-A (21) or AD × 100 / CP length. (5)

5. Distance between the ischial tuberosity and the acetabulum's rim (most distant) (14) (Fig.4)

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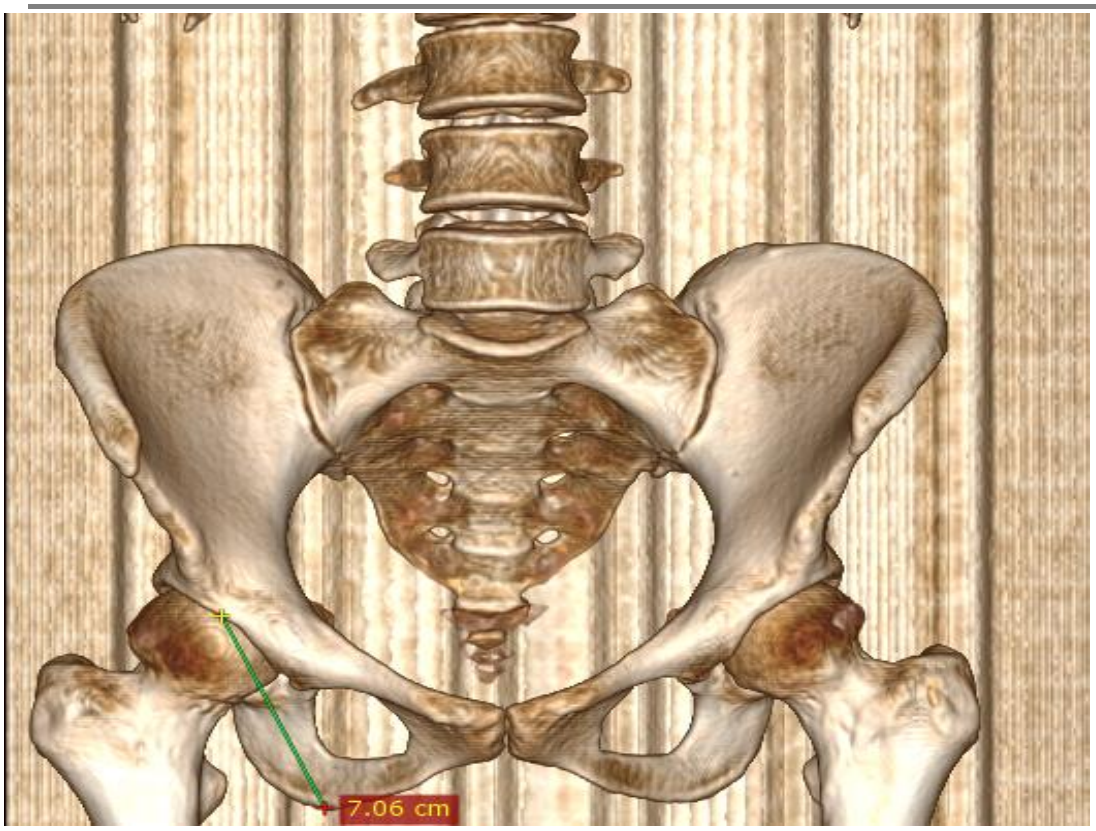

Figure.4. Figure displays the length measured from the ischial tuberosity to the acetabulum's margin.

We studied the gender differences among the patients. Continuous variables were expressed as means and standard deviations. The independent sample T test was employed to contrast the groups because the data was shown to be regularly distributed. The statistical analysis was performed using SPSS software (SPSS Inc.; Chicago, IL) version 29.0.10.

RESULTS

The descriptive prospective research study involved 132 patients in total, 59 of whom were males and 73 of whom were females. The Department of Radio-diagnosis and Imaging at Teerthanker Mahaveer Hospital, in Moradabad, Uttar Pradesh, received referrals for CT pelvis imaging from several departments.

Table 1: Descriptive Statistics for age, and the acetabular standards

(n = 132)	Range	Mean	S.D.
Age (Years)	20 to 80	41.1	15.3
AD (mm)	37.5 to 57.9	47.5	4.1
TAD (mm)	32.2 to 54.6	44.7	3.8
CP length (mm)	66.3 to 42	86.9	6.3
AP index (mm)	97.1 to 76.4	55.0	7.3
Length from ischial tuberosity to rim of acetabulum (mm)	66.2 to 105.7	82.7	7.8

Table 2: Age and gender distribution

(n = 132)		Frequency	%
Age groups	20-35	61	46.2
	36-55	42	31.8
	56-80	29	22
Gender	Male	59	44.7
	Female	73	55.3

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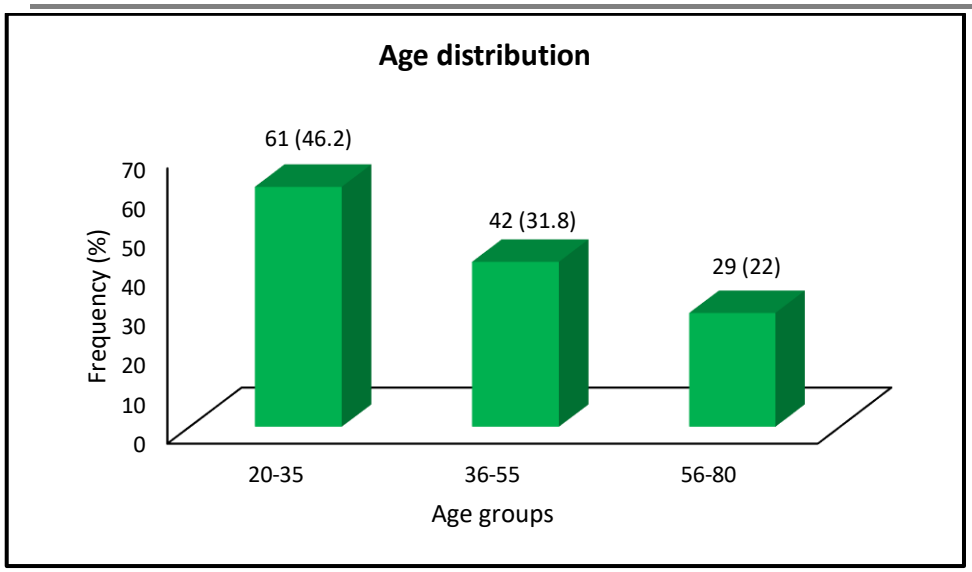
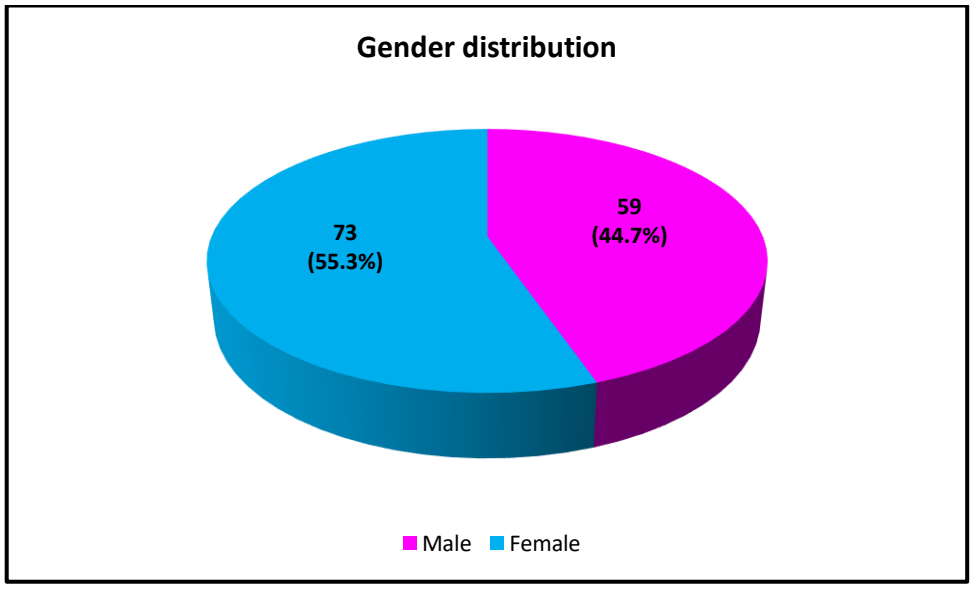


Graph 1: Age distribution

This graph shows the frequency of age group distribution, the age divided into three groups (20-35, 36-55, 56-80). In this graph the highest range is of the 20-35 age group.



Graph 2: Distribution of genders

This graph shows the distribution of gender; the total number of males is 59 (44.7%) and females is 73 (55.3%). The higher total number is present in males in comparison to females.

Table 3: Age according to gender

		Gender			
		Male		Female	
		n	%	n	%
Age groups	20-35	26	44.1	35	47.9
	36-55	18	30.5	24	32.9
	56-80	15	25.4	14	19.2

This table shows the age according to gender there are three age groups. In the first age group (20-35) there are 26 (44.1%) males and 35 (47.9%) females. In the second group (36-55) there are 18(30.5%) males and 24 (32.9%) females. In the third age group (56-80) there are 15 (25.4%) males and 14 (19.2%) females.

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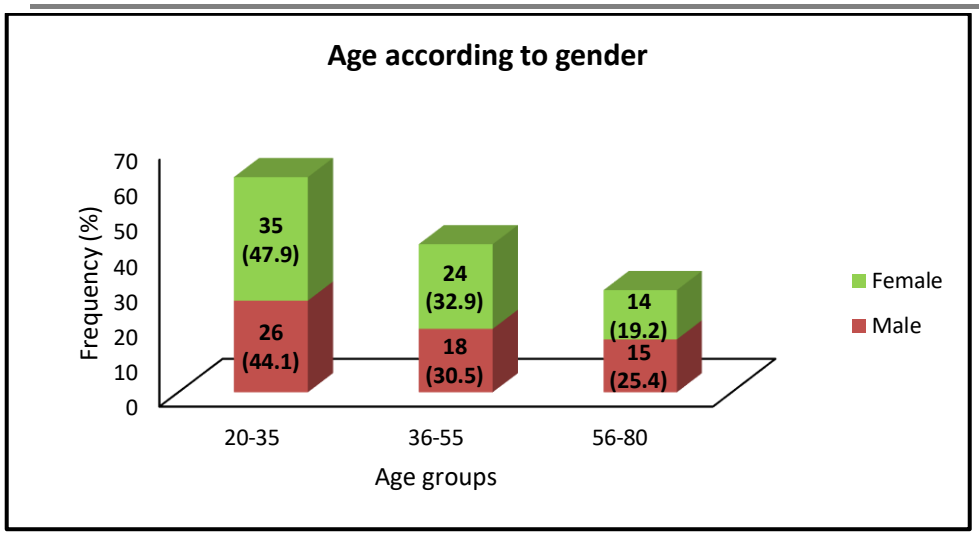


Graph 3: Age according to gender

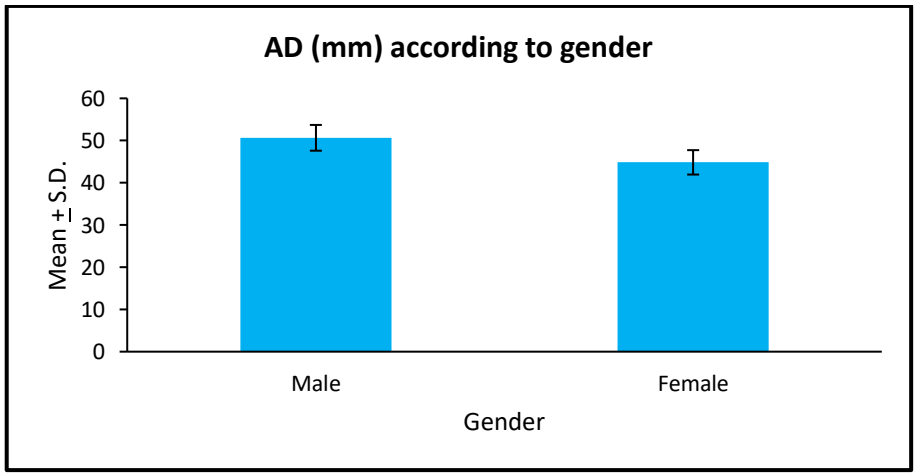
This graph shows the distribution of age according to gender there are three age groups. In the first age group (20-35) there are 26 (44.1%) males and 35 (47.9%) females. In the second group (36-55) there are 18 (30.5%) males and 24 (32.9%) females. In the third age group (56- 80) there are 15 (25.4%) males and 14 (19.2%) females. The higher range of the 20-35 age group.

Table 4: Comparison of acetabular standards according to gender

		Mean	S.D.	"t"	p value
AD (mm)	Male	50.7	3.1	11.20	< 0.001*
	Female	44.8	2.9		
TAD (mm)	Male	46.9	3.1	7.30	< 0.001*
	Female	42.8	3.3		
CP length (mm)	Male	81.9	4.6	-11.44	< 0.001*
	Female	90.8	4.3		
AP index (mm)	Male	61.9	4.2	18.57	< 0.001*
	Female	49.4	3.5		
Length from ischial tuberosity to rim of acetabulum (mm)	Male	87.9	6.4	8.53	< 0.001*
	Female	78.5	6.1		

("t" = Independent sample "t" test; * Significant)

The Independent sample "t" test was used to compare the acetabular standards according to gender. There was a difference ($p < 0.05$) in the entire parameters of acetabular standards: AD, TAD, CP length, AP index, and the length from ischial tuberosity to rim of acetabulum; between males and females. [Table – 4]



Graph 4: A D (mm) according to gender

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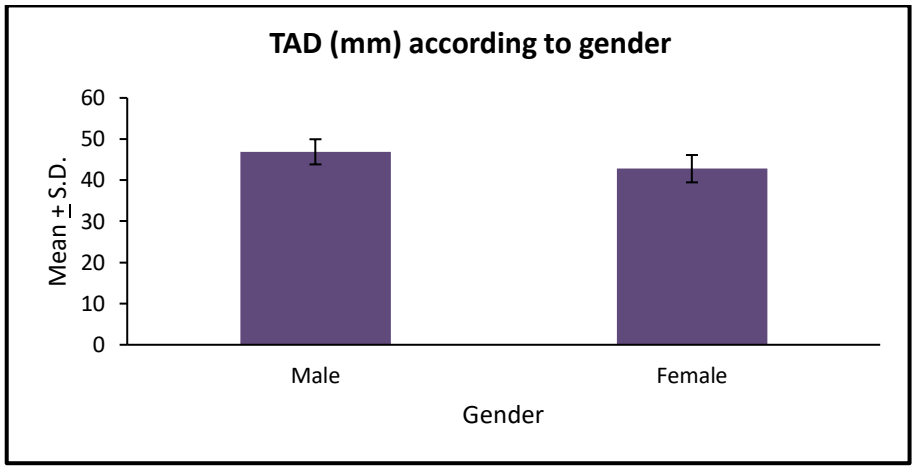
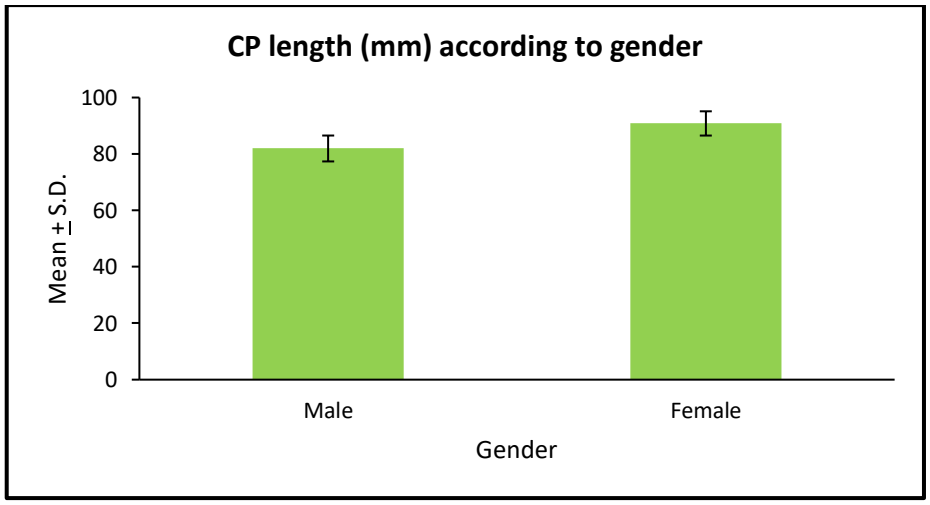
This graph shows the comparison of AD according to gender. In the AD, the highest mean accuracy is present in the males in comparison to females.



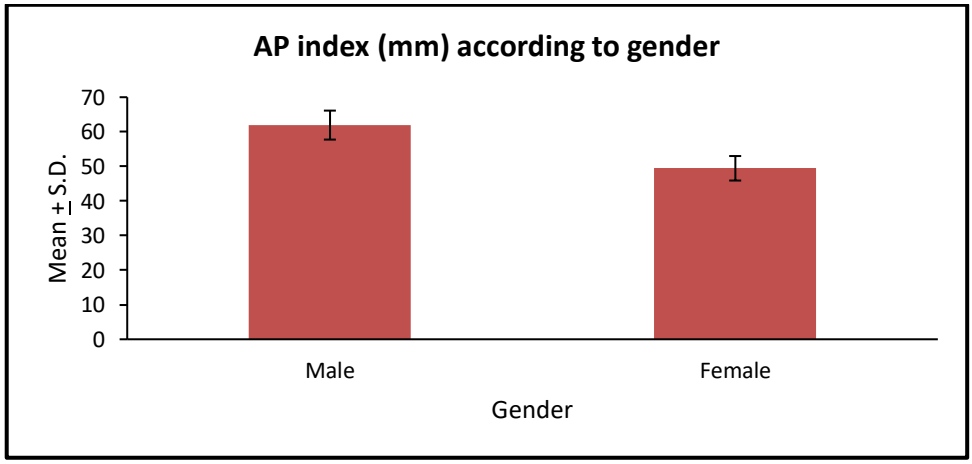
Graph 5: TAD (mm) according to gender

This graph shows the comparison of TAD according to gender. In the TAD, the highest mean accuracy is present in the males in comparison to females.



Graph 6: CP length (mm) according to gender

This graph shows the comparison of CP length according to gender. In the CP length, highest mean accuracy is present in the females in comparison to males.



Graph 7: AP index (mm) according to gender

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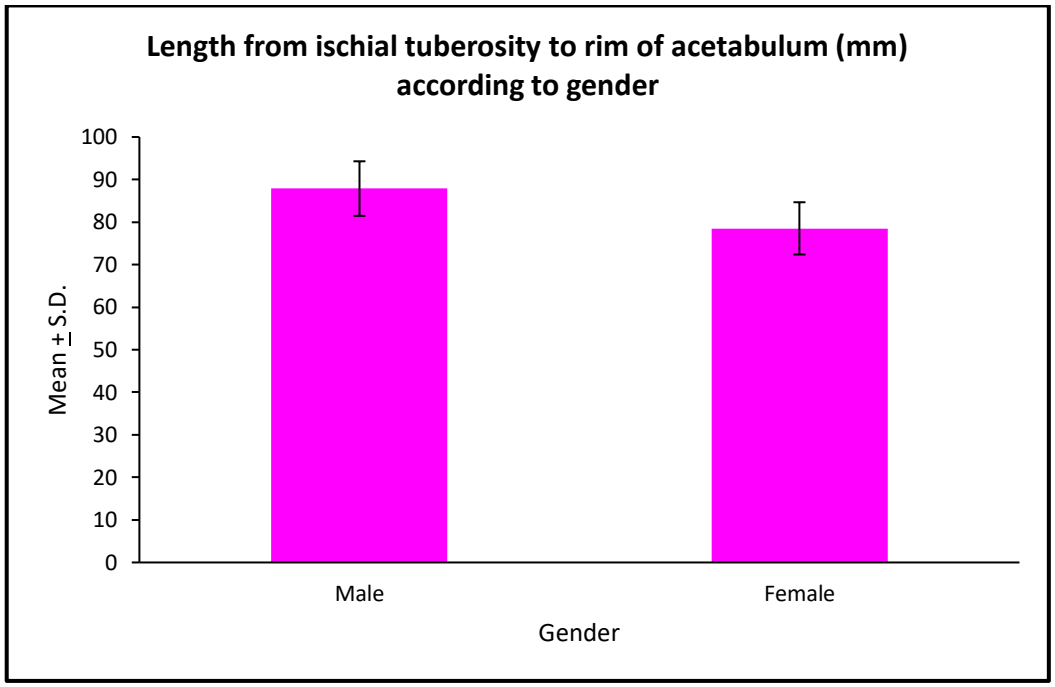
This graph shows the comparison of AP index according to gender. In the AP index, the highest mean accuracy is present in the males in comparison to females.



Graph 8: Length from ischial tuberosity to rim of acetabulum (mm) according to gender

This graph shows the comparison of Length from ischial tuberosity to rim of acetabulum according to gender. In the Length from ischial tuberosity to rim of acetabulum , the highest mean accuracy is present in the males in comparison to females.

Table 5: Comparison of acetabular standards according to age groups

	Age groups	Mean	S.D.	"F"	p value
AD (mm)	20-35	47.0	3.8	14.51	< 0.001*
	36-55	50.7	3.7		
	56-80	50.0	3.4		
TAD (mm)	20-35	44.4	3.2	15.73	< 0.001*
	36-55	44.9	4.5		
	56-80	49.1	3.9		
CP length (mm)	20-35	86.5	6.6	4.56	0.012*
	36-55	87.8	5.5		
	56-80	83.6	3.9		
AP index (mm)	20-35	54.7	7.0	4.99	0.008*
	36-55	54.9	7.4		
	56-80	59.3	5.3		
Length from ischial tuberosity to rim of acetabulum (mm)	20-35	82.2	7.7	12.44	< 0.001*
	36-55	83.5	7.9		
	56-80	91.4	10.0		

("F" = One-way ANOVA; * Significant)

The One-way ANOVA was used to compare the acetabular standards according to age groups. There was a difference ($p < 0.05$) in the entire parameters of acetabular standards: AD, TAD, CP length, AP index, and the length from ischial tuberosity to rim of acetabulum; according to age groups. [Table – 5]

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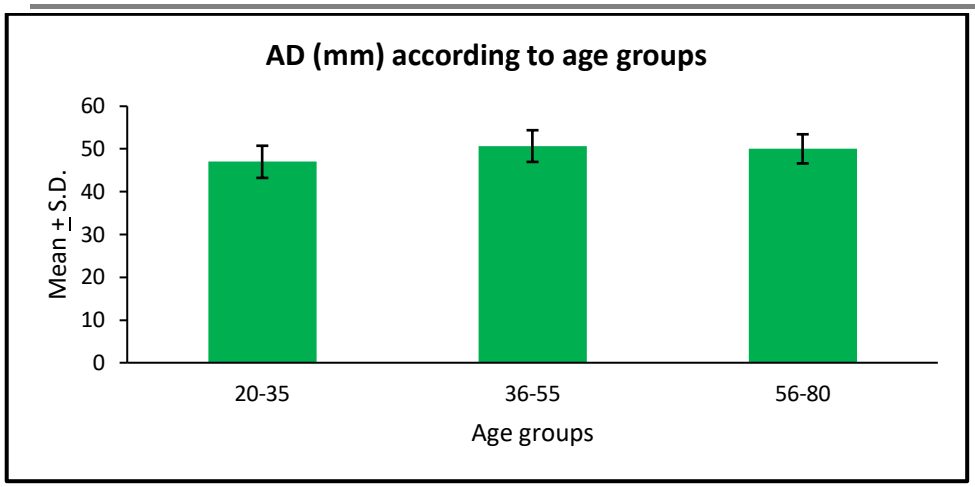
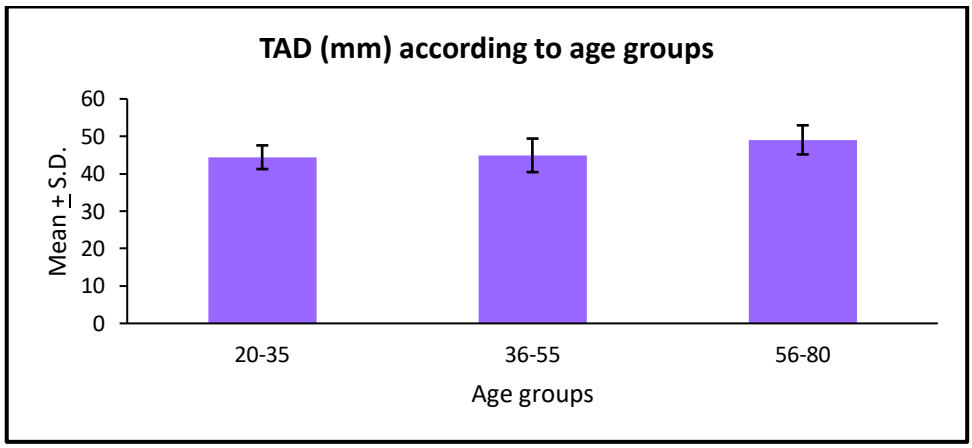


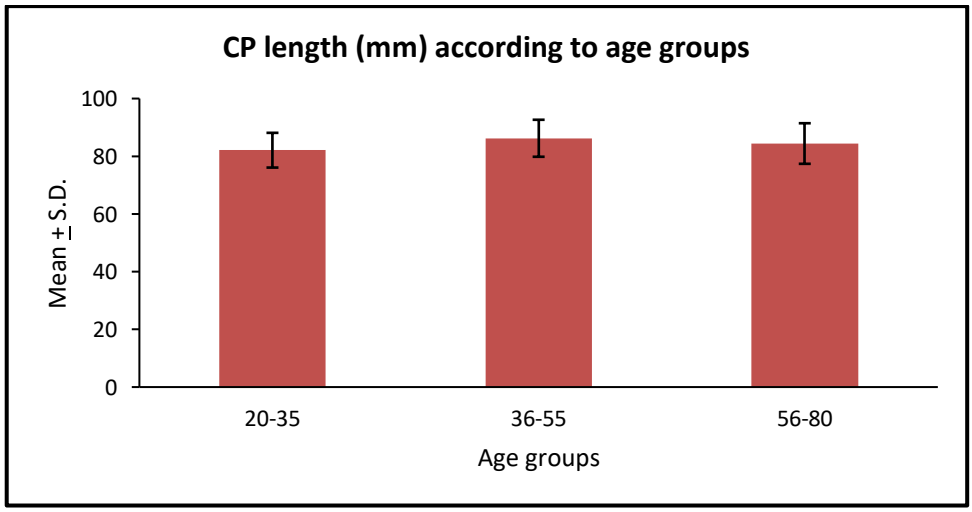
Graph 9: Acetabular diameter according to age

This graph shows the comparison of the AD according to age groups. In the AD, the highest mean accuracy is present in the 36-55 age group.



Graph 10: TAD (mm) according to age

This graph shows the comparison of the TAD according to age groups. In theTAD, the highest mean accuracy is present in the 56-80 age group.



Graph 11: CP length (mm) according to age

This graph shows the comparison of the CP length according to age groups. In the CP length, the highest mean accuracy is present in the 36-55 age group.

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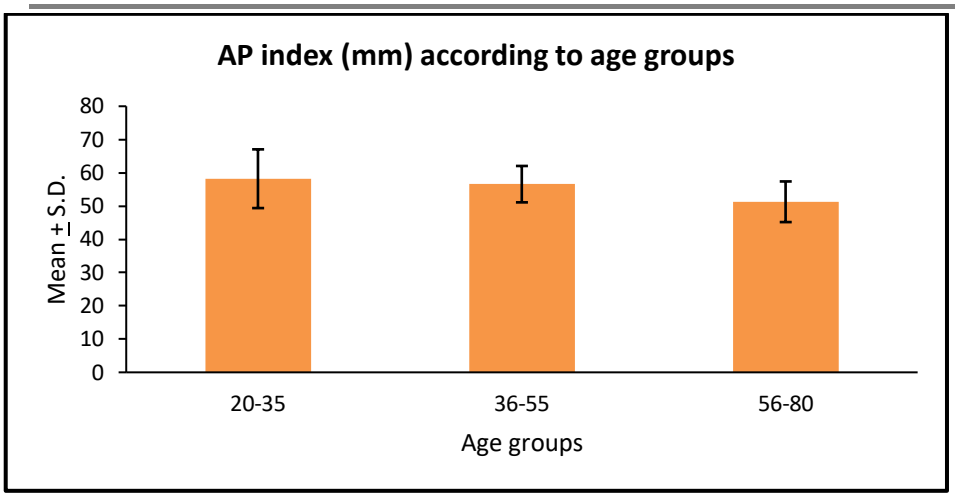
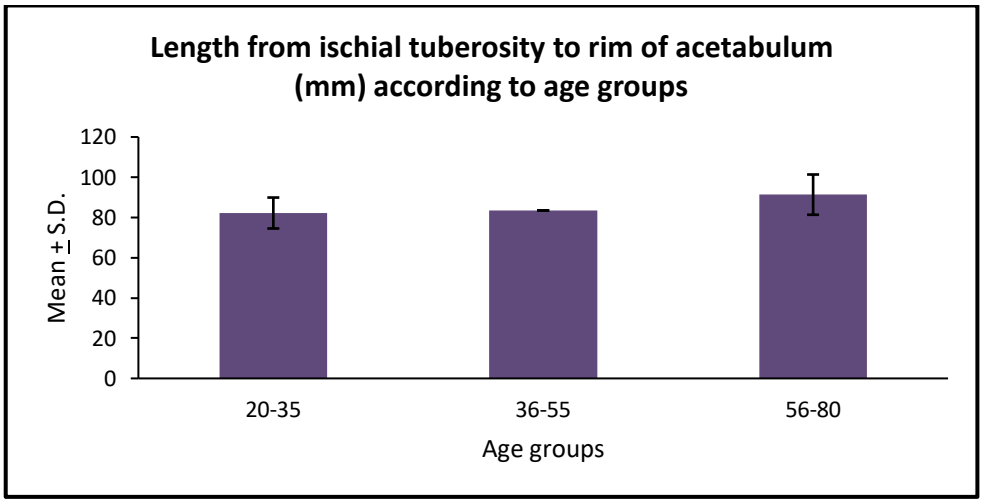


Graph 12: AP index (mm) according to age

This graph shows the comparison of the AP index according to age groups. In the, AP index the highest mean accuracy is present in the 36-55 age group.



Graph 13: Length from ischial tuberosity to rim of acetabulum (mm) according to age.

This graph shows the comparison of the Length from ischial tuberosity to rim of acetabulum according to age groups. In the Length from ischial tuberosity to rim of acetabulum, the highest mean accuracy is present in the 56-80 age group.

Table 6: Multiple comparisons of acetabular standards according to age groups

Multiple comparisons		Mean Difference	p value
AD (mm)	20-35 vs. 36-55	-3.69	< 0.001*
	20-35 vs. 56-80	-3.03	0.001*
	36-55 vs. 56-80	0.66	0.050*
TAD (mm)	20-35 vs. 36-55	-0.50	0.048*
	20-35 vs. 56-80	-4.64	< 0.001*
	36-55 vs. 56-80	-4.14	< 0.001*
CP length (mm)	20-35 vs. 36-55	-1.27	0.039*
	20-35 vs. 56-80	2.91	0.050*
	36-55 vs. 56-80	4.18	0.009*
AP index (mm)	20-35 vs. 36-55	-0.16	0.0.47*
	20-35 vs. 56-80	-4.57	0.009*
	36-55 vs. 56-80	5.29	0.009*

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Length from ischial tuberosity to rim of acetabulum (mm)	20-35 vs. 36-55	-1.28	0.050*
	20-35 vs. 56-80	-9.14	< 0.001*
	36-55 vs. 56-80	-7.86	< 0.001*

(* Significant)

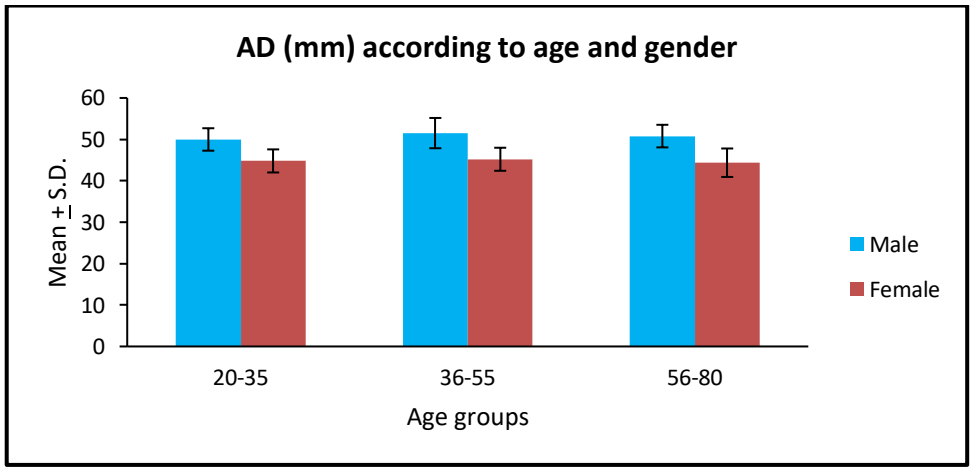
The Post hoc analysis, Tukey test was used for the multiple comparisons of acetabular standards according to age groups. There was a difference ($p < 0.05$) in acetabular standards: AD, TAD, CP length, AP index, and the length from ischial tuberosity to rim of acetabulum; between the age groups: 20-35 vs. 36-55; 20-35 vs. 56-80; and 36-55 vs. 56-80. [Table –6]

Table 7: Comparison of acetabular standards between males and females within the age group

	Age groups	Gender				"t"	p value
		Male		Female			
		Mean	S.D.	Mean	S.D.		
AD (mm)	20-35	50.0	2.7	44.8	2.8	7.27	< 0.001*
	36-55	51.5	3.7	45.2	2.8	6.36	< 0.001*
	56-80	50.8	2.7	44.4	3.4	5.61	< 0.001*
TAD (mm)	20-35	46.5	2.8	42.9	2.6	5.17	< 0.001*
	36-55	47.5	3.8	43.0	4.1	3.60	0.001*
	56-80	47.0	2.7	42.1	3.8	4.05	< 0.001*
CP length (mm)	20-35	81.4	5.2	90.3	4.8	-6.98	< 0.001*
	36-55	82.7	3.4	91.6	3.3	-8.60	< 0.001*
	56-80	82.0	4.9	90.7	4.7	-4.86	< 0.001*
AP index (mm)	20-35	61.5	3.3	49.7	4.1	12.07	< 0.001*
	36-55	62.3	4.5	49.3	2.8	11.52	< 0.001*
	56-80	62.2	5.2	49.0	3.5	7.96	< 0.001*
Length from ischial tuberosity to rim of acetabulum (mm)	20-35	88.1	6.0	77.9	5.7	6.78	< 0.001*
	36-55	89.1	6.4	79.3	6.3	4.98	< 0.001*
	56-80	86.1	7.2	78.8	7.3	2.70	0.012*

("t" = Independent sample "t" test; * Significant)

The Independent sample "t" test was used to compare the acetabular standards according to gender within the age groups. There was a difference ($p < 0.05$) entire parameters of acetabular standards: AD, TAD, CP length, AP index, and the length from ischial tuberosity to rim of acetabulum; between males and females within the entire age groups: 20-35, 36-55, and 56-80. [Table – 7]



Graph 14: AD (mm) according to age and gender

This graph shows the comparison of the AD according to age and gender. In the AD, the highest mean accuracy is present in the males in each group and the highest mean accuracy is present in the 36-55 age group.

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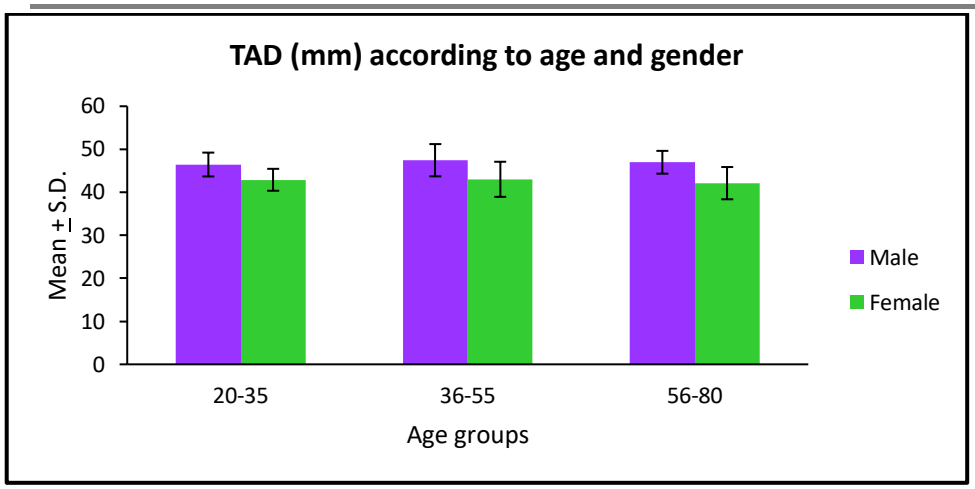
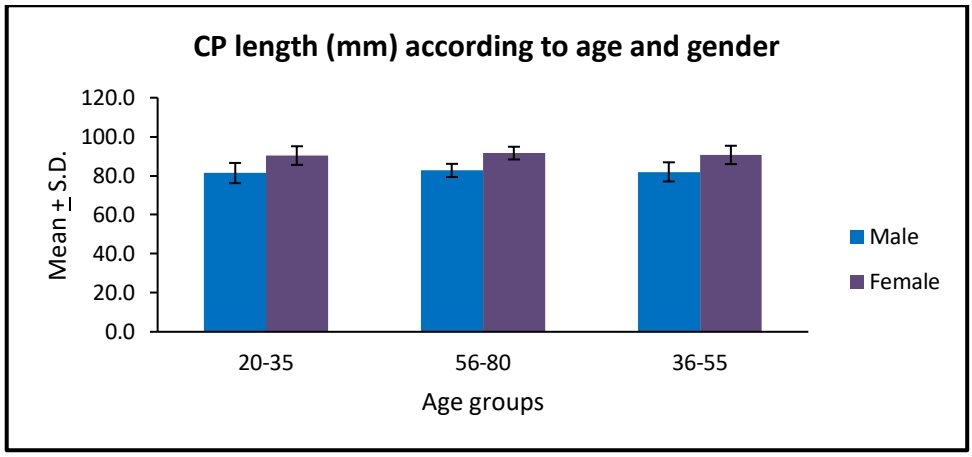


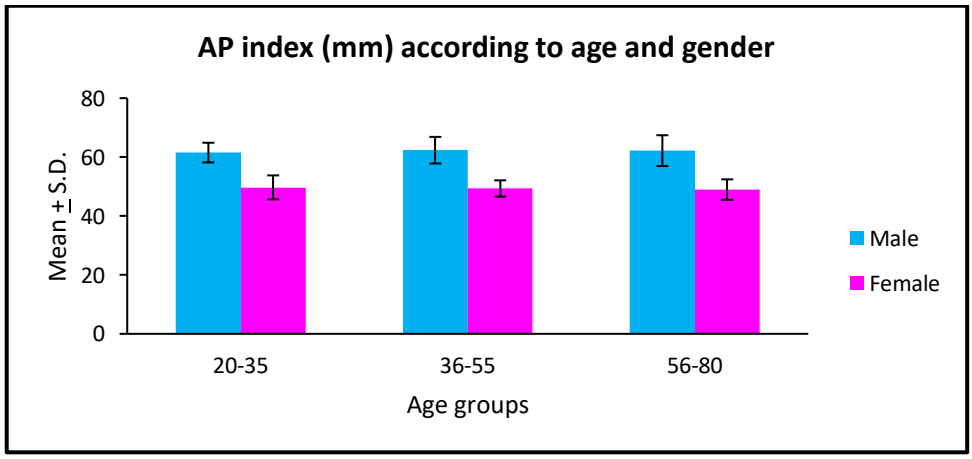
Graph 15: TAD (mm) according to age and gender

This graph shows the comparison of the TAD according to age and gender. In the TAD, the highest mean accuracy is present in the males in each group and the highest mean accuracy is present in the 36-55 and 56-80 age groups.



Graph 16: CP length (mm) according to age and gender

This graph shows the comparison of the CP length according to age and gender. In the CP length, the highest mean accuracy is present in the females in each group and the highest mean accuracy is present in the 56-80 age groups.



Graph 17: AP index (mm) according to age and gender

This graph shows the comparison of the AP index according to age and gender. In the AP index, the highest mean accuracy is present in the males in each group and the highest mean accuracy is present in the 20-35, 36-55 and 56-80 age groups.

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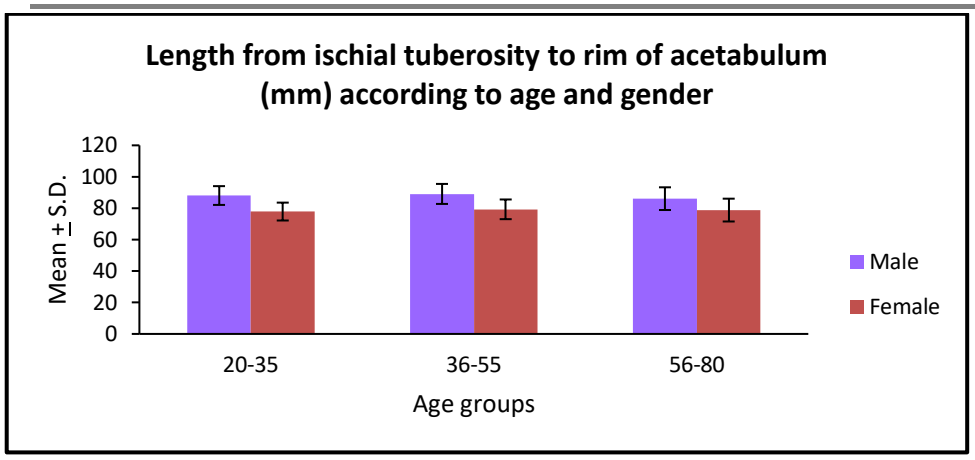


Graph 18: Length from ischial tuberosity to rim of acetabulum according to age and gender.

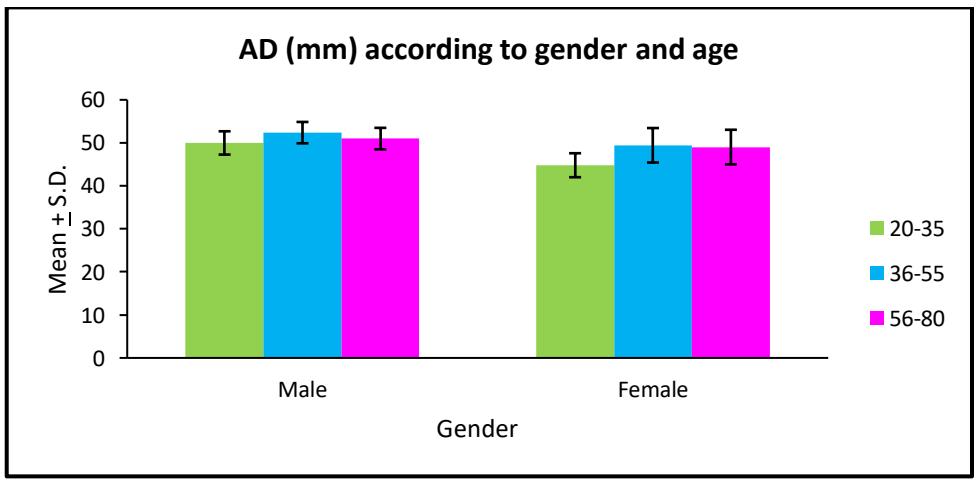
This graph shows the comparison of the Length from ischial tuberosity to rim of acetabulum according to age and gender. In the length from ischial tuberosity to rim of acetabulum, the highest mean accuracy is present in the males in each group and the highest mean accuracy is present in the 36-55 age group.

Table 8: Comparison of acetabular standards according to age group within gender

	Gender	Age groups						"F"	p value
		20-35		36-55		56-80			
		Mean	S.D.	Mean	S.D.	Mean	S.D.		
AD (mm)	Male	50.0	2.7	52.4	2.5	51.0	2.5	4.54	0.015*
	Female	44.8	2.8	49.4	4.0	49.0	4.0	15.26	< 0.001*
TAD (mm)	Male	46.5	2.8	47.5	3.8	50.0	2.7	6.15	0.004*
	Female	42.9	2.6	43.0	4.1	48.1	4.7	11.65	< 0.001*
CP length (mm)	Male	86.6	5.2	82.7	3.4	82.1	4.7	6.02	0.004*
	Female	90.3	4.8	91.6	3.3	85.2	2.0	12.42	< 0.001*
AP index (mm)	Male	63.1	3.1	62.3	4.5	62.2	5.2	7.28	0.003*
	Female	49.7	4.1	49.3	2.8	56.3	3.2	20.33	< 0.001*
Length from ischial tuberosity to rim of acetabulum (mm)	Male	88.1	6.0	89.1	6.4	91.1	9.2	3.86	0.017*
	Female	77.9	5.7	79.3	6.3	91.7	11.2	19.40	< 0.001*

("F" = One-way ANOVA; * Significant)

The One-way ANOVA was used to compare acetabular standards according to age group within gender. There was a difference ($p < 0.05$) in the entire parameters of acetabular standards: AD, TAD, CP length, AP index, and the length from ischial tuberosity to rim of acetabulum; according to age groups among males. [Table – 8]



Graph 19: AD (mm) according to gender and age

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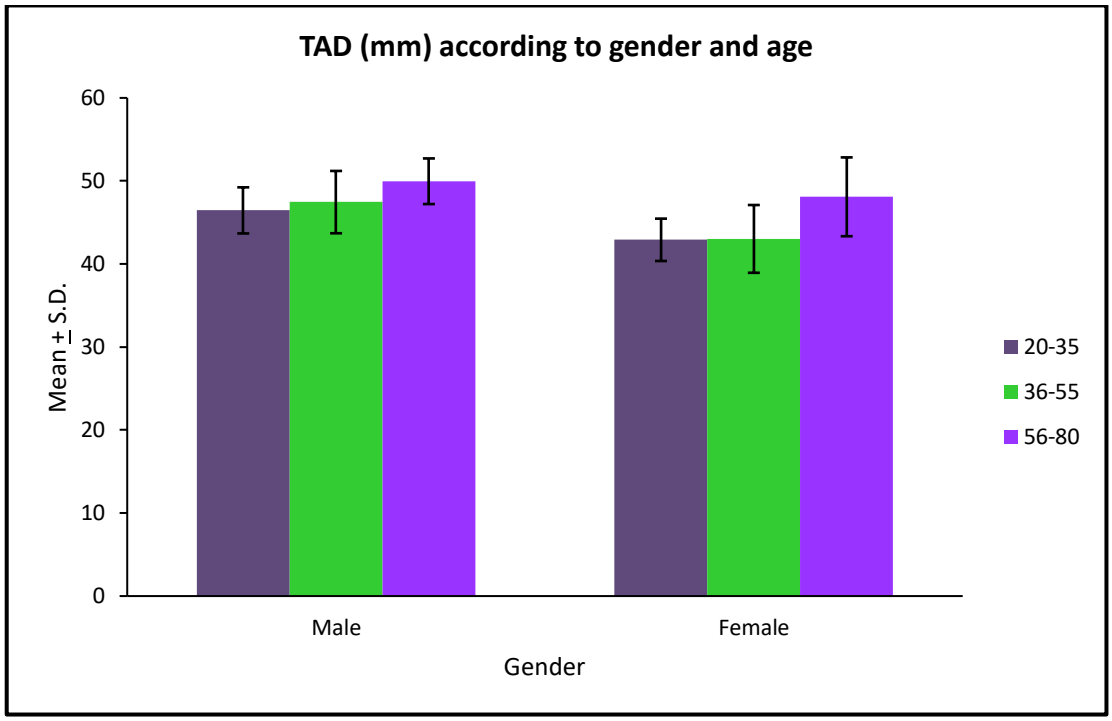
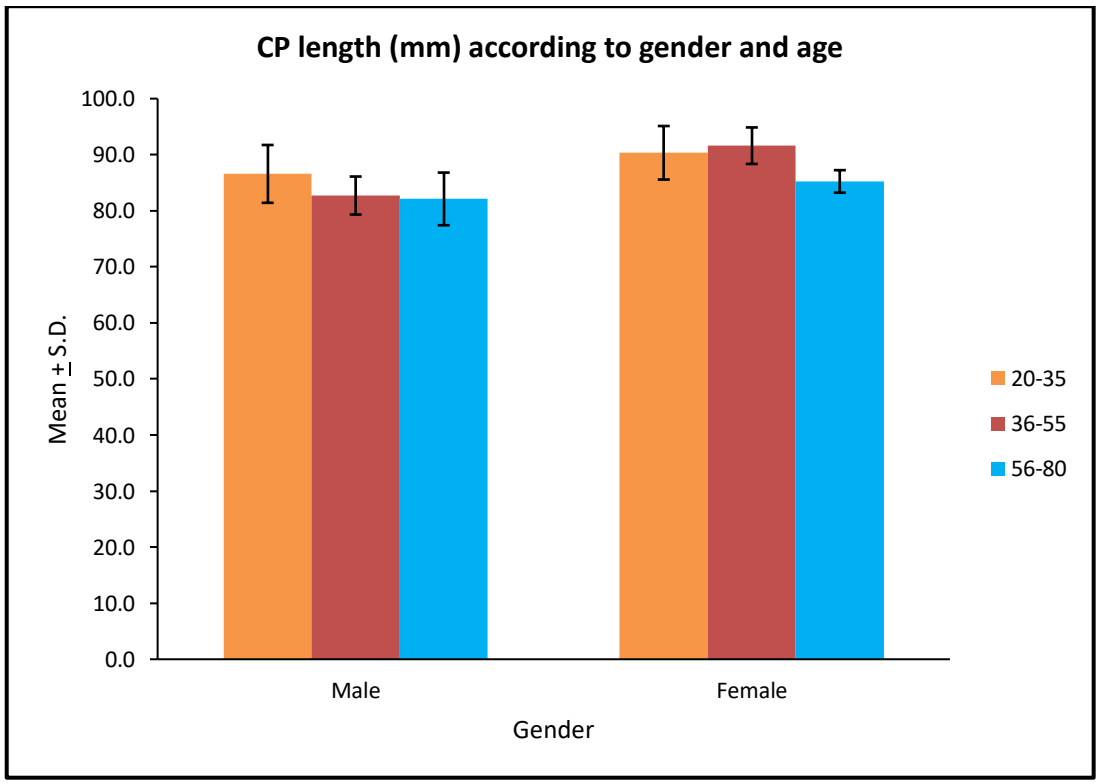
This graph shows the comparison of AD according to gender and age in males and females. The highest mean accuracy is present in males in the 36-55 age groups.



Graph 20: TAD (mm) according to gender and age

This graph shows the comparison of TAD according to gender and age in males and females. The highest mean accuracy is present in males in the 56-80 age groups.



Graph 21: CP length (mm) according to gender and age

This graph shows the comparison of CP length according to gender and age in males and females. The highest mean accuracy is present in females in the 36-55 age groups.

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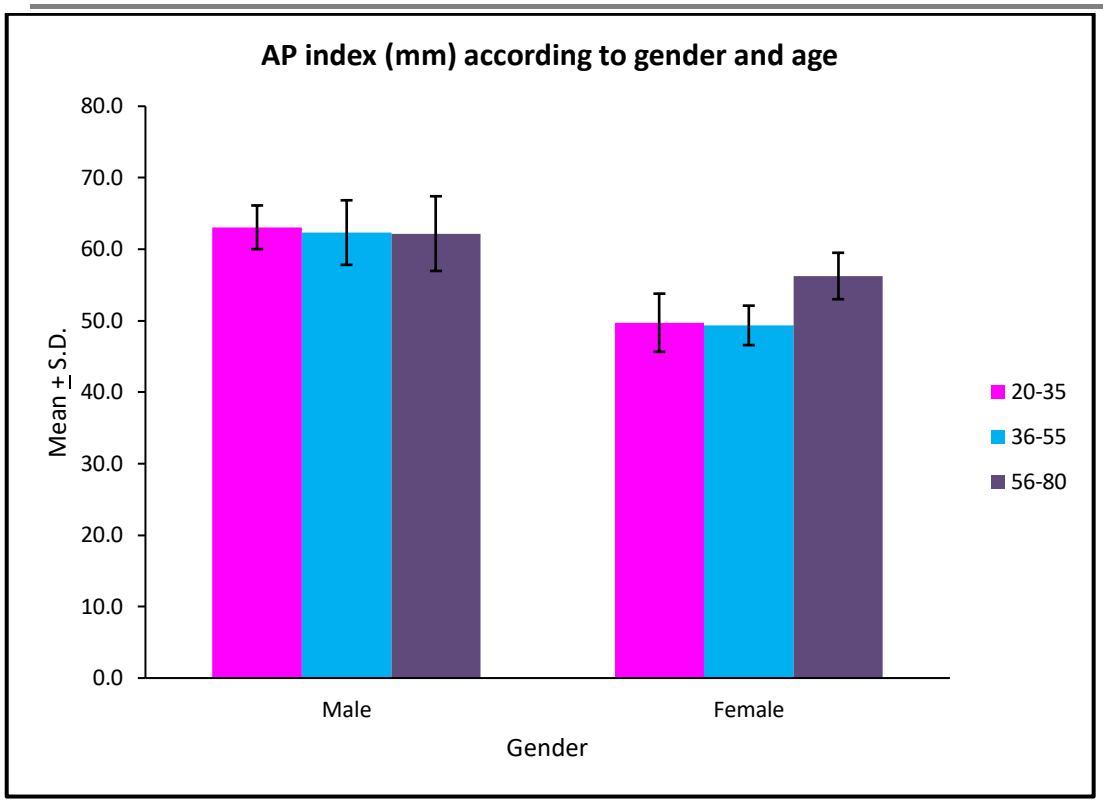
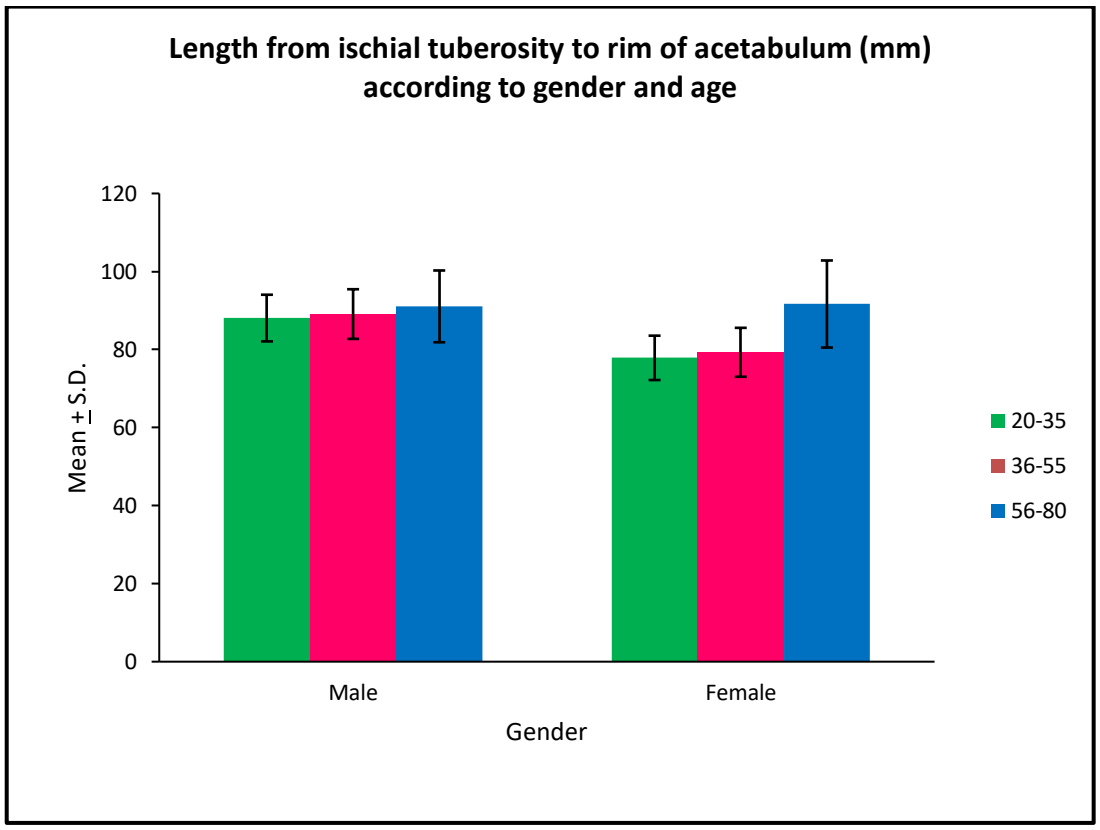


Graph 22: AP index (mm) according to gender and age

This graph shows the comparison of AP index according to gender and age in males and females. The highest mean accuracy is present in males in the 20-35 age groups.



Graph 23: Length from ischial tuberosity to rim of acetabulum (mm) according to gender and age

This graph shows the comparison of Length from ischial tuberosity to rim of acetabulum according to gender and age in males and females. The highest mean accuracy is present in females in the 56-80 age groups.

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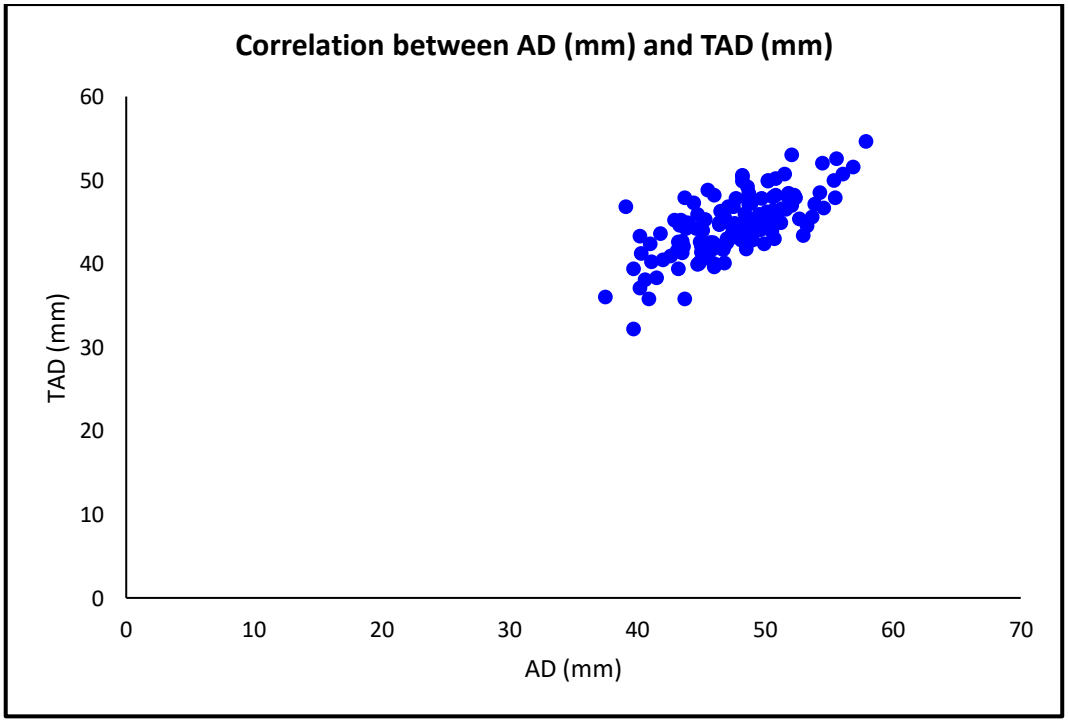
Table 9: Relation between the various parameters of acetabular standards

		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.708	-0.349	0.843	0.593
	p value	--	< 0.001*	< 0.001*	< 0.001*	< 0.001*
TAD (mm)	"r"		1	-0.253	0.604	0.540
	p value		--	0.003*	< 0.001*	< 0.001*
CP length (mm)	"r"			1	-0.793	-0.317
	p value			--	< 0.001*	< 0.001*
AP index (mm)	"r"				1	0.554
	p value				--	< 0.001*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), AP index (mm) as well as length from ischial tuberosity to rim of acetabulum (mm); and negatively correlated ($p < 0.05$) with CP length (mm). The TAD (mm) was positively correlated ($p < 0.05$) with AP index (mm) as well as length from ischial tuberosity to rim of acetabulum (mm); and negatively correlated ($p < 0.05$) with CP length (mm). The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm) and length from ischial tuberosity to rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm). [Table – 9]



Graph24: Correlation between AD (mm) and TAD (mm)

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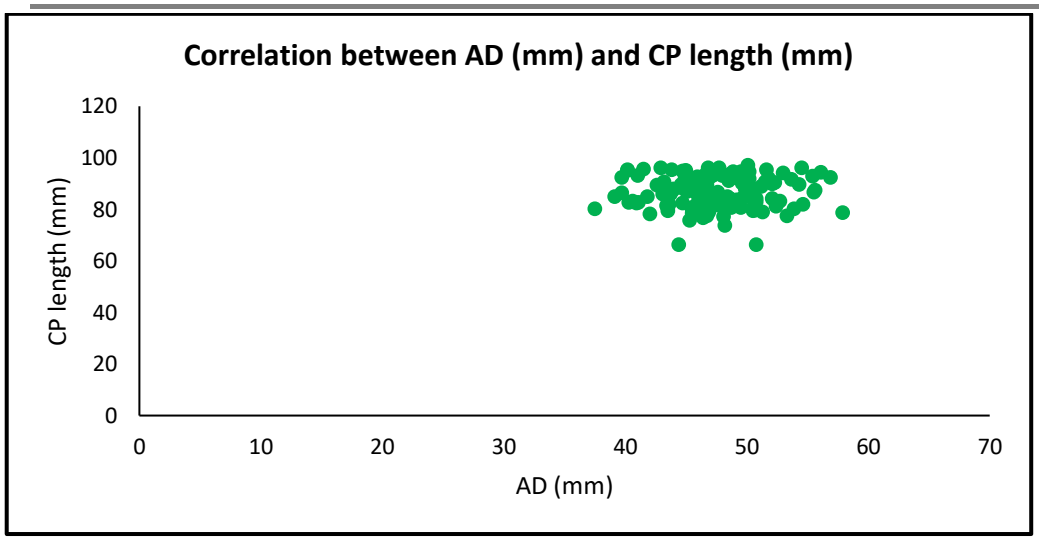
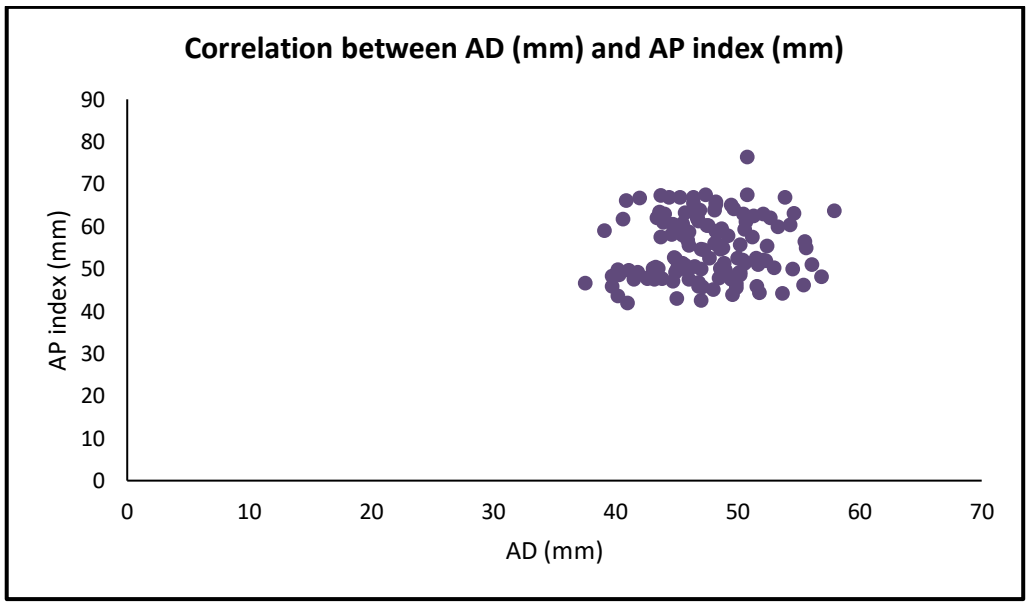
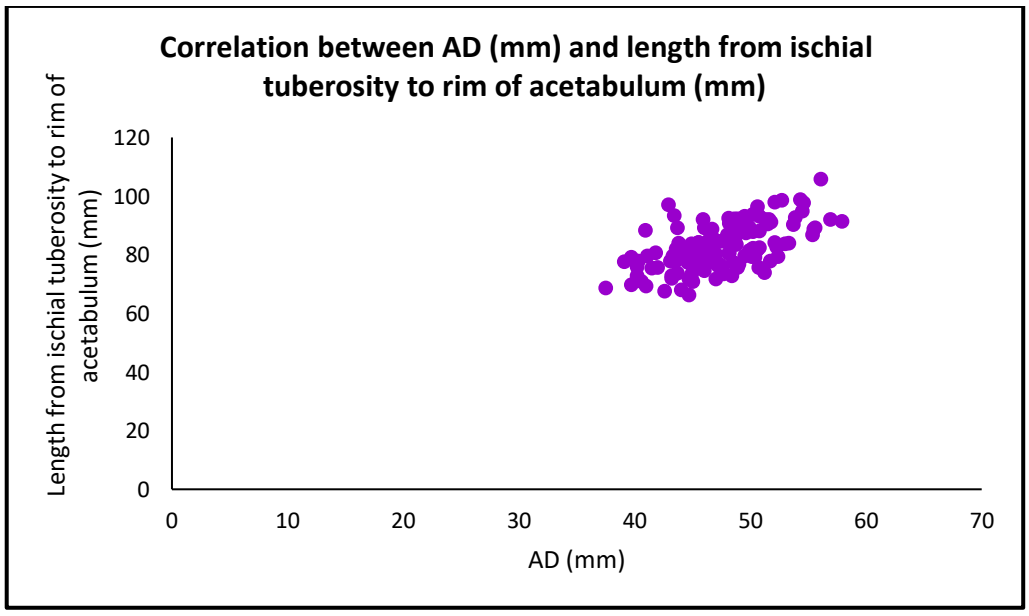


Graph25: Correlation between AD (mm) and CP length (mm)



Graph26: Correlation between AD (mm) and AP index (mm)



Graph27: Correlation between AD (mm) and length from ischial tuberosity to rim of acetabulum (mm)

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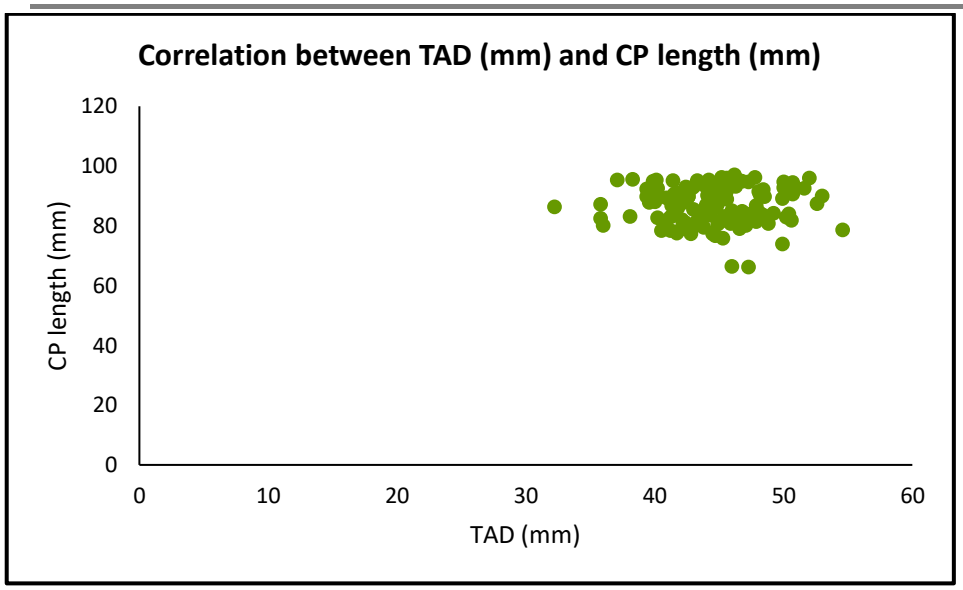
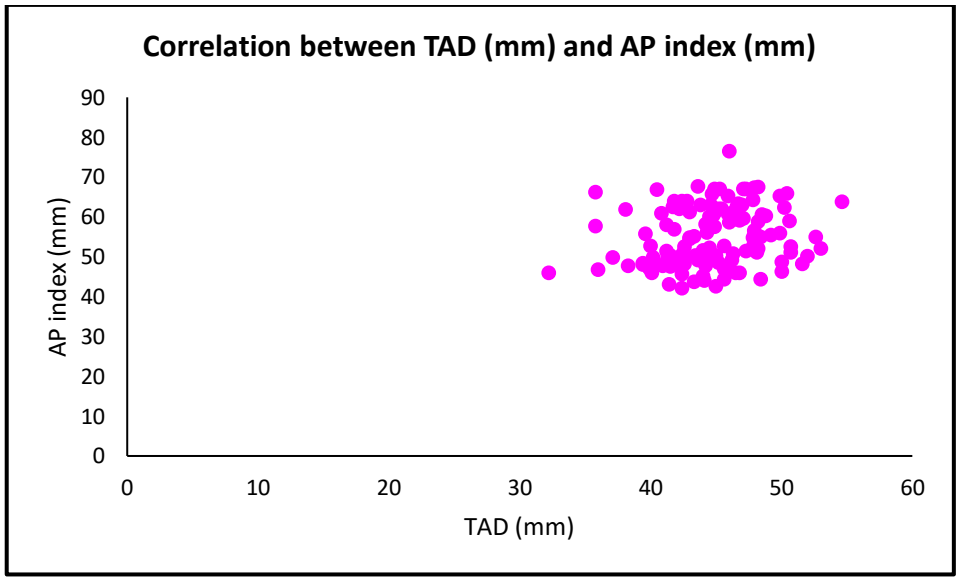
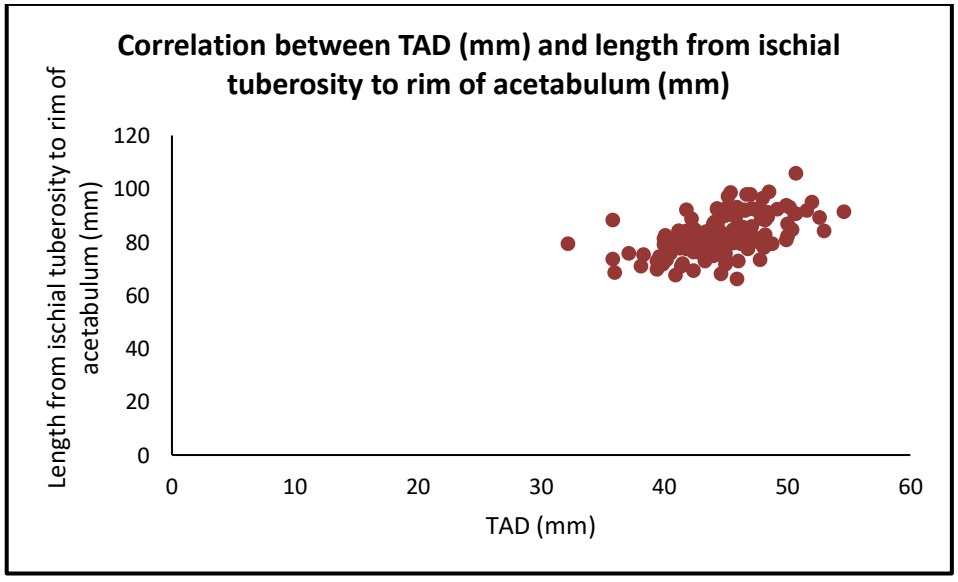


Graph28: Correlation between TAD (mm) and CP length (mm)



Graph29: Correlation between TAD (mm) and AP index (mm)



Graph30: Correlation between TAD (mm) and length from ischial tuberosity to rim of acetabulum (mm)

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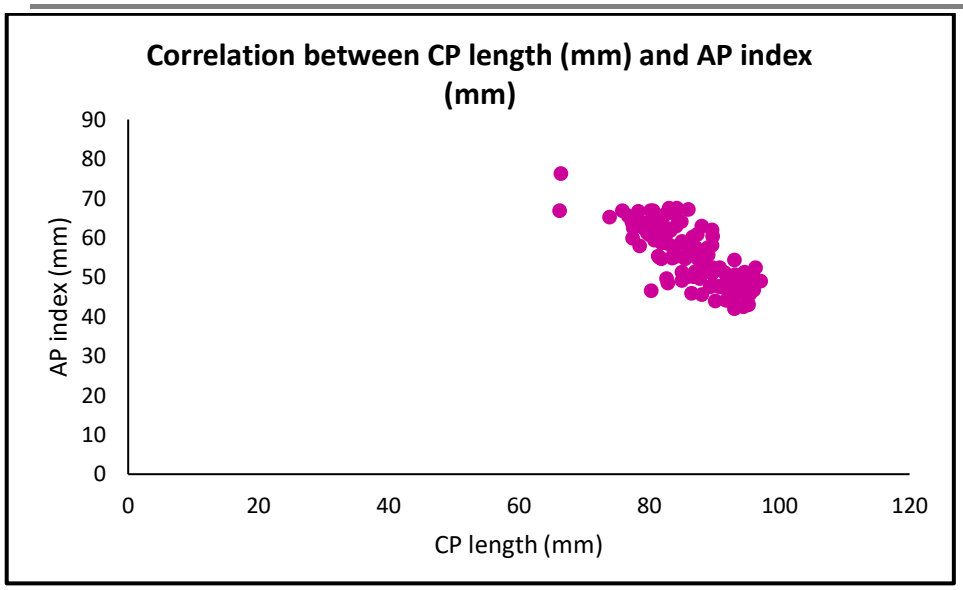
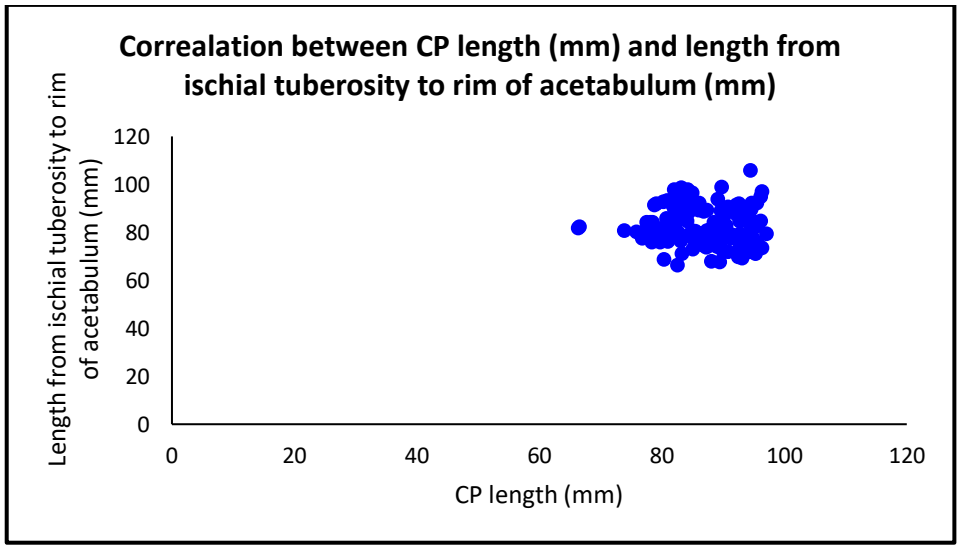
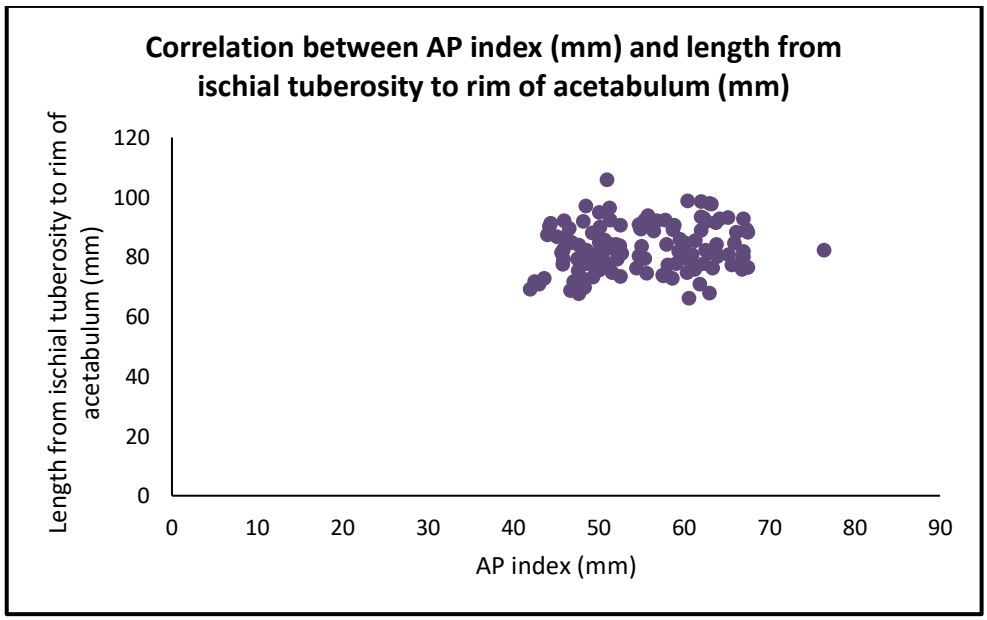


Graph31: Correlation between CP length (mm) and AP index (mm)



Graph32: Correlation between CP length (mm) and length from ischial tuberosity to rim of acetabulum (mm)



Graph33: Correlation between AP index (mm) and length from ischial tuberosity to rim of acetabulum (mm)

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Table 10: Relation between the various parameters of acetabular standards among males

		Male				
		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.591	0.358	0.572	0.390
	p value	--	< 0.001*	0.005*	< 0.001*	0.002*
TAD (mm)	"r"		1	0.175	0.368	0.323
	p value		--	0.048*	0.004*	0.013*
CP length (mm)	"r"			1	-0.557	0.380
	p value			--	< 0.001*	0.003*
AP index (mm)	"r"				1	0.015
	p value				--	0.050*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards among males. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm). The TAD (mm) was positively correlated ($p < 0.05$) with CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm); among males. The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm) and was positively correlated ($p < 0.05$) with the length from ischial tuberosity to rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm); among males. [Table – 10]

Table 11: Relation between the various parameters of acetabular standards among females

		Female				
		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.518	0.234	0.747	0.225
	p value	--	< 0.001*	0.046*	< 0.001*	0.050*
TAD (mm)	"r"		1	0.252	0.299	0.322
	p value		--	0.032*	0.010*	0.005*
CP length (mm)	"r"			1	-0.469	0.020
	p value			--	< 0.001*	0.049*
AP index (mm)	"r"				1	0.195
	p value				--	0.050*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards; among females. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm). The TAD (mm) was positively correlated ($p < 0.05$) with CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm); among females. The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm); and it was positively correlated ($p < 0.05$) with the length from ischial tuberosity to

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rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm); among females. [Table – 11]

Table 12: Relation between the various parameters of acetabular standards among the age group: 20 – 35 years

		Age group: 20 - 35 years				
		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.597	-0.317	0.800	0.657
	p value	--	< 0.001*	0.013*	< 0.001*	< 0.001*
TAD (mm)	"r"		1	-0.251	0.529	0.523
	p value		--	0.050*	< 0.001*	< 0.001*
CP length (mm)	"r"			1	-0.819	-0.342
	p value			--	< 0.001*	0.007*
AP index (mm)	"r"				1	0.602
	p value				--	< 0.001*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards among the age group: 20 – 35 years. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm). The TAD (mm) was positively correlated ($p < 0.05$) with CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm) among the age group: 20 – 35 years. The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm) and length from ischial tuberosity to rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm); among the age group: 20 – 35 years. [Table – 12]

Table 13: Relation between the various parameters of acetabular standards among the age group: 36 - 55 years

		Age group: 36-55 years				
		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.735	-0.429	0.902	0.597
	p value	--	< 0.001*	0.005*	< 0.001*	< 0.001*
TAD (mm)	"r"		1	-0.293	0.651	0.652
	p value		--	0.049*	< 0.001*	< 0.001*
CP length (mm)	"r"			1	-0.775	-0.395
	p value			--	< 0.001*	0.010*
AP index (mm)	"r"				1	0.602
	p value				--	< 0.001*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards; among the age group: 36 - 55 years. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum

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(mm). The TAD (mm) was positively correlated ($p < 0.05$) with CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm); among the age group: 36 - 55 years. The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm) and length from ischial tuberosity to rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm); among the age group: 36 - 55 years. [Table – 13]

Table 14: Relation between the various parameters of acetabular standards among the age group: 56-80 years

		Age group: 56-80 years				
		AD (mm)	TAD (mm)	CP length (mm)	AP index (mm)	Length from ischial tuberosity to rim of acetabulum (mm)
AD (mm)	"r"	1	0.825	-0.365	0.845	0.472
	p value	--	< 0.001*	0.048*	< 0.001*	0.010*
TAD (mm)	"r"		1	-0.256	0.670	0.401
	p value		--	0.045*	< 0.001*	0.031*
CP length (mm)	"r"			1	-0.796	-0.213
	p value			--	< 0.001*	0.050*
AP index (mm)	"r"				1	0.415
	p value				--	0.025*
Length from ischial tuberosity to rim of acetabulum (mm)	"r"					1
	p value					--

("r" = Pearson correlation coefficient; * Significant)

The Pearson correlation coefficient ("r") was used to find the relation between the various parameters of acetabular standards; among the age group: 56-80 years. The AD (mm) was positively correlated ($p < 0.05$) with TAD (mm), CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm). The TAD (mm) was positively correlated ($p < 0.05$) with CP length (mm), AP index (mm), and the length from ischial tuberosity to rim of acetabulum (mm); among the age group: 56-80 years. The CP length (mm) was negatively correlated ($p < 0.05$) with AP index (mm) and length from ischial tuberosity to rim of acetabulum (mm). Also, there was a positive correlation ($p < 0.05$) between AP index (mm) and the length from ischial tuberosity to rim of acetabulum (mm); among the age group: 56-80 years. [Table – 14]

DISCUSSION

In our investigation, we take 132 patients in total (59 male and 73 female) and 5 parameters for determining the sex, both AD and TAD showed a gap between men & women that is statistically significant based on gender. Both parameters are greater in males in comparison to females. When the acetabular measures between men & women inside the age groups were compared, age groups showed a difference (P<.05) in AD and TAD. Among both the acetabular measures analysed based on gender within an age group, only AD has a greater value in men than in women in comparison with ***Pero Bubalo et al.***

AP index was detected between males and females where P-value (P<0.001). The CP length (mm) was correlated negatively ($p < 0.05$) to AP index (mm) and was correlated positively ($p < 0.05$) to the length from ischial tuberosity to rim of acetabulum (mm) among males as well as in females. AD was positively correlated to CP length and AP index in both males and females. AD and AP index were significantly larger whereas CP length was smaller in males when compared to females in comparison with ***Panneer selvi G et al.***

We compare the length from ischial tuberosity to rim of acetabulum according to gender and age in males and females. In the length from ischial tuberosity to rim of acetabulum, there was a discrepancy in determining gender. As shown in graph 23, in the age group of 20-35 years and 36-55 years males have a higher value than females whereas females have greater value than males in the age group of 56-80 years.

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Our study's drawback is that prevalence was not calculated using a hospital cohort but rather a general sample. Nevertheless, patients with no hip problems were used in the investigation. An improved understanding of India's acetabular morphology would result from a multicentric study involving people from all throughout the nation.

CONCLUSION

In situations where gender determination is essential to establishing the deceased's identity, such as disfigured remains, severely decomposed corpses, bomb blasts, burned bodies from burns, etc., the results of this study will undoubtedly help determine bone sex. Compared to other bones like the skull, long bones, etc., which have a relatively lower proportion of accurate sexing, the pelvis is said to be the best bone for identifying gender because of its higher percentage.

Unlike other morphometric and morphological methods that require both sides to have innominate hip bones, the results of this study can also be utilized to sex archaeological skeletal remains because just one side hip bone is needed.

To increase the accuracy of gender determination for the North Indian population, the different characteristics obtained from this study can therefore be used with other hip bone parameters that are traditionally applied.

Ethical Clearance: This study was approved by the board of review at the institution.

Informed consent: Every individual participant in the study gave their informed consent.

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