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A Morphometric Study of Iliac Crest of Hip Bone to Determine the Favourable Site for Harvesting Bone Graft

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Abstract: ***Objectives: To assess and compare the Computed Tomographic images of the hip bone aong various ages and gender to determine the favourable site for bone graft harvesting. Materials and methods: A total of 52 patients admitted in Gadag Institute of Medical Sciences who had done CT - Hip for various pathological conditions were assessed and width of Iliac crest was assessed in the respective CT - Scans at 5cm, 6cm, 8cm, 10cm on both left side and right side and this data was compiled together to get the maximum width ideal for bone graft and its compared across the various age groups and genders. Results: The mean width of the iliac crest for age less than 40 include at 5cm is 16.34mm, at 6cm is 15.20mm, at 8cm is 12.39mm, at 10cm is 10.91mm and for age more than 40 years include at 5cm is 16.16mm, at 6cm is 15.09, at 8cm 12.04 and at 10cm is 10.80mm on right side and for the age less than 40 include at 5cm is 16.26mm, at 6cm is 15.20mm, at 8cm is 12.40mm, at 10cm is 10.88mm and for age more than 40 years include at 5cm is 16.09mm, at 6cm is 15.08, at 8cm 12.05 and at 10cm is 10.79mm on right side. Conclusion: The maximum amount of cancellous bone required for bone graft in iliac crest is situated in the widest part of iliac crest which is around 5cm to 8cm from the tip of Anterior superior iliac spine. There was statistical significance in terms of gender or age for width of the iliac crest.***

Keywords: Iliac crest bone graft, Bone graft harvesting

1. Introduction

The iliac crest is the thick curved upper border of the ilium, the most prominent bone on the pelvis. It is palpable through its extent. It extends from anterior superior iliac spine to the posterior superior iliac spine with upwards convexity [1]. The crest is convex superiorly but is sinuously curved, being concave inward in front, concave outward behind [2]. The iliac crest has ventral segment that is anterior 2/3rd and dorsal segment or posterior 1/3rd. It divides into an outer and inner lip separated by the intermediate zone. The bone grafting is a very common surgical procedure for orthopaedic and reconstructive surgeons [3, 4, 5, 6].

The harvested bone graft is used in Spinal fusion, Maxillofacial reconstruction, and many Orthopedic procedures [7]. As the harvested iliac crest autograft has Osteogenic, osteoconductive and osteogenic properties. There are many techniques of harvesting Iliac crest bone graft which include anterior apporach (ASIS) posterior approach (PSIS), many minimally invasive was have been proposed which reduce the post operative pain and morbidity [8]. The compliocations of Bone grafting include pain, injury to neurovascular structures, infection, hematoma, fractures of iliac bone, etc [9]. The morphometric study uses the non invasive imaging methods to asses the favourable site for bone graft harvesting across various age groups and genders and also compare them.

2. Materials and Methods

Present study was carried out in department of Orthopedics of Gadag Institute of Medical Sciences, Gadag. A morphometric study of the iliac crest using CT (Computed Tomography) of the hip involves a detailed analysis of the bony structures of the iliac crest to assess its shape, dimensions, and other anatomical characteristics. To assess the morphometric variability of the iliac crest, evaluate sex - related differences, or study its implications in surgical procedures like bone grafting.

A sample size of 52 was taken depnding upon the number of CT - HIP were done in the department of Orthopedics from the period of January 2024 to April 2024.

CT Imaging Protocol: High - resolution CT scans of the hip region with 2mm slice thickness for detailed bone analysis. Scanning Parameters were consistent across all subjects for comparability, such as: Tube voltage (kVp), Tube current (mA), Slice thickness and spacing, Reconstruction algorithms.

Positioning: Standardize the positioning of patients during CT acquisition (supine, legs neutral or slightly rotated) to avoid distortions in the iliac crest's anatomical measurements.

Morphometric Parameters: Crest Thickness: Measurement of the thickness of the iliac crest at different points along its length (at 5cm, 6cn, 8cm and 10cm from the tip of the ASIS).

Image Analysis and Measurements: CT analysis software RadiAnt DICOM Viewer used to measure the parameters.

3D Reconstruction: Create 3D reconstructions of the iliac crest using the CT data to improve measurement accuracy.

Landmark Identification: Anatomical landmarks such as

the ASIS, PSIS, iliac tubercle were identified to standardize measurements across subjects.

Measurement Protocol: 2 measurements taken for each parameter to ensure reliability and consistency.

Data Collection: All morphometric measurements recorded in a structured dataset.

Statistical Analysis: Descriptive and Comparative analysis used using ANOVA test.

3. Results

Sample distribution by gender

		Frequency	Percent
Gender	Male	26	50.0
	Female	26	50.0
	Total	52	100.0

Sample distribution by age group

		Frequency	Percent
Valid	<40 yrs	26	50
	> 40yrs	26	50
	Total	52	100

Group Statistics

	Ages	N	Mean	Std. Deviation	Std. Error Mean
Righ_iliac5	<40 yrs	26	16.3408	1.82713	0.35833
	> 40yrs	26	16.1681	2.24406	0.4401
Righ_iliac6	<40 yrs	26	15.2019	1.86881	0.3665
	> 40yrs	26	15.0965	2.18695	0.4289
Righ_iliac8	<40 yrs	26	12.3981	0.89617	0.17575
	> 40yrs	26	12.0446	1.04233	0.20442
Righ_iliac10	<40 yrs	26	10.9188	0.99608	0.19535
	> 40yrs	26	10.8019	1.09098	0.21396
Left_iliac5	<40 yrs	26	16.2638	1.76001	0.34517
	> 40yrs	26	16.0935	2.16574	0.42474
Left_iliac6	<40 yrs	26	15.2004	1.84479	0.36179
	> 40yrs	26	15.0804	2.15331	0.4223
Left_iliac8	<40 yrs	26	12.4065	0.93631	0.18363
	> 40yrs	26	12.0519	1.02384	0.20079
Left_iliac10	<40 yrs	26	10.8846	1.00417	0.19693
	> 40yrs	26	10.7981	1.07235	0.21031

Independent sample t - test of both sides iliac5 to 10, with age group

Independent Samples Test

	t - test for Equality of Means			
	t	df	Sig. (2 - tailed)	Mean Difference
Righ_iliac5	0.304	50	0.762	0.17269
Righ_iliac6	0.187	50	0.853	0.10538
Righ_iliac8	1.311	50	0.196	0.35346
Righ_iliac10	0.404	50	0.688	0.11692
Left_iliac5	0.311	50	0.757	0.17038
Left_iliac6	0.216	50	0.83	0.12
Left_iliac8	1.303	50	0.198	0.35462
Left_iliac10	0.3	50	0.765	0.08654

The <40 years group has a mean of 16.34 (SD = 1.83). The >40 years group has a mean of 16.17 (SD = 2.24). For **Righ_iliac5**, the t - value is 0.304, with a p - value of 0.762. Since the p - value is much greater than 0.05, the difference in means between the two age groups is **not statistically significant**. Similarly, for all other variables (Righ_iliac6, Righ_iliac8, Left_iliac5, etc.), the p - values are all greater than 0.05, indicating **no statistically significant differences** between the <40 and >40 age groups in these measurements.

Group Statistics

	Sex	N	Mean	Std. Deviation	Std. Error Mean
Righ_iliac5	Male	26	16.6408	1.83758	0.36038
	Female	26	15.8681	2.16854	0.42529
Righ_iliac6	Male	26	15.5265	1.67044	0.3276
	Female	26	14.7719	2.27915	0.44698
Righ_iliac8	Male	26	12.4338	0.61263	0.12015
	Female	26	12.0088	1.21872	0.23901
Righ_iliac10	Male	26	11.1008	0.76076	0.1492
	Female	26	10.62	1.22089	0.23944
Left_iliac5	Male	26	16.5188	1.75307	0.3438
	Female	26	15.8385	2.11877	0.41553
Left_iliac6	Male	26	15.505	1.64519	0.32265
	Female	26	14.7758	2.2504	0.44134
Left_iliac8	Male	26	12.4173	0.57644	0.11305
	Female	26	12.0412	1.25876	0.24686

Independent Samples Test

	t - test for Equality of Means			
	t	df	Sig. (2 - tailed)	Mean Difference
Righ_iliac5	1.386	50	0.172	0.77269
Righ_iliac6	1.362	50	0.179	0.75462
Righ_iliac8	1.589	50	0.118	0.425
Righ_iliac10	1.704	50	0.095	0.48077
Left_iliac5	1.262	50	0.213	0.68038
Left_iliac6	1.334	50	0.188	0.72923
Left_iliac8	1.385	50	0.172	0.37615
Left_iliac10	1.949	50	0.057	0.54192

For **Righ_iliac5**, the mean measurement for males is 16.64 with a standard deviation (SD) of 1.84, while for females, the mean is 15.87 with an SD of 2.17. For **Righ_iliac6**, the mean for males is 15.53 (SD = 1.67), and for females, the mean is 14.77 (SD = 2.28). **Righ_iliac8 and 10**, and **Left_iliac regions** follow similar trends, with males generally having slightly higher mean measurements compared to females.

T - Test

Group Statistics

	Side	N	Mean	Std. Deviation	Std. Error Mean
iliac5	Right	52	16.2544	2.02796	.28123
	Left	52	16.1787	1.95578	.27122
iliac6	Right	52	15.1492	2.01477	.27940
	Left	52	15.1404	1.98616	.27543
iliac8	Right	52	12.2213	.97883	.13574
	Left	52	12.2292	.98775	.13698
iliac10	Right	52	10.8604	1.03600	.14367
	Left	52	10.8413	1.02951	.14277

Independent Samples Test

	t - test for Equality of Means			
	t	df	Sig. (2 - tailed)	Mean Difference
iliac5	0.194	102	0.847	0.07577
iliac6	0.023	102	0.982	0.00885
iliac8	-0.041	102	0.967	-0.00788
iliac10	0.094	102	0.925	0.01904

4. Conclusion

In conclusion, the mophometric study of iliac crest of hip bone analyses the most favourable site for harvesting the bone graft leading to reduced complications like inntertable bone breach and lets the surgeons understand the precise location for harvesting the maximum bone graft leading to improved recovery and better functional results.

The maximum amount of cancellous bone required for bone graft in iliac crest is situated in the widest part of iliac crest which is around 5cm to 8cm from the tip of Anterior superior iliac spine. There was statistical significance in terms of gender or age for width of the iliac crest.

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