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ASSESSMENT OF BONE INJURY IN RECURRENT SHOULDER DISLOCATION USING CT AND SURGICAL CORRELATION IN A RURAL HEALTH SET UP

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INTRODUCTION :

Glenohumeral joint stability has two components- soft tissue and bone support. Adequate soft tissue coverage is required both anteriorly and posteriorly.

Anterior shoulder dislocation frequently causes bone loss on the anterior aspect of the glenoid with fracture of the posterosuperior aspect of the humeral head, known as Hill-Sachs deformity. Glenoid bone loss decreases the glenohumeral contact area which increases joint instability and the possibility of further dislocation. (13)

The anatomy of the glenoid cavity is intricate, complex and varies between individuals.
Plain CT scan of the shoulder allows us to evaluate the glenoid cavity and its rim, and 3-D reconstruction allows both the radiologist and the surgeon to visualise the defect on a bony model. 3D reconstructed images gives us the maximum amount of information regarding details of osseous injury and its severity. (4,5,6,7)

The evaluation of osseous injury and glenoid bone loss helps the surgeon to select the most appropriate treatment - be it arthroscopic procedures such as arthroscopic soft tissue stabilisation or open procedures, or whether bone grafting is required.

AIMS & OBJECTIVES:

1. To determine the percentage of bone loss using 3 dimensional CT.
2. To study degree of accuracy of preoperative CT imaging in relation to surgical intervention and findings.

MATERIALS AND METHODS:

Source of data: Patients coming to Orthopedics department in MVJ Medical College and Research Hospital for unilateral recurrent shoulder dislocation from August 2022 to December 2023.

Method of collection of data: 30 patients enrolled after taking informed consent. Patients with unilateral recurrent shoulder dislocation presenting to Radiology Department for CT shoulder

Study design: Prospective study

Material: NCCT study of shoulder joint at MVJ MC & RH using GE Bravo 16 slice CT machine

Sample: Patients attending MVJ Medical College and Research Hospital, Hoskote, Bangalore, Karnataka.

Time period: 16 months

Sample size: 30 cases

Inclusion criteria:

1. Patients with recurrent, unilateral shoulder dislocation, occurring more than or equal to 3 times
2. Patients who are willing for surgical management.

Exclusion criteria:

1. Patients who have previously undergone surgery on the affected side.
2. Patients with bilateral recurrent shoulder dislocation
3. Patients with contraindications for CT scanning, such as pregnancy.
4. Patients who have epilepsy or seizure disorder.

Method:

3D reconstructions of the humeral head and glenoid of both shoulder joints with 16 slice scans converted to 3-D CT reconstructions by combined standard and bone algorithms were performed.

Linear method used to calculate the amount of bone loss of the injured glenoid compared to the uninjured contralateral glenoid.

The first step in the process was obtaining an en face view of the uninjured glenoid with the 3-D CT scan. The most superior aspect of the glenoid is labeled as A1. The most inferior aspect of the glenoid is the farthest point from A1 and is labeled B1. A line is then drawn connecting A1 to B1 (A1B1). The line A1B1 corresponds to the normal glenoid height (H1) of the uninjured shoulder (A1B1 = H1).

The second line drawn (C1D1) is perpendicular to A1B1 and is adjusted up or down until it is at the widest portion of the inferior glenoid. The line C1D1 corresponds to the normal inferior glenoid width (W1) of the uninjured shoulder (C1D1 =W1).

The intersection of lines A1B1 and C1D1 is labeled O1. The line O1D1 corresponds to the radius of the normal inferior glenoid circle (R1) of the uninjured shoulder (O1D1=R1).
The length of the glenoid is measured ias the uninjured glenoid and line A2B2 (H2) is drawn. The radius of the inferior glenoid circle was then calculated through basic proportions. Because R1/H1 =R2/H2, R2 could be calculated by the following formula**: R2=(R1/H1)*H2**.

Therefore, the geometric center of the inferior glenoid circle (O2) could be found a distance equal to R2 from the point B2.

A new line is drawn that crosses point O2 and is perpendicular to line A2B2. This line is labeled C2D2 and represents the inferior width of the injured glenoid (W2).

The predicted preinjury width of the injured glenoid (W2') can then be calculated with the following formula: **W2 '= (W1/H1)*H2**.

The glenoid index is calculated as the ratio of the post injury width of the injured glenoid to the preinjury width of the uninjured glenoid using the following formula: **glenoid index =W2/W2'**.

RESULTS:

Age distribution:

Out of 30 cases, patients below 19yrs of age were 13.3%(4), 20-29 years of age - 53.3%(16), 30-39 yrs of age - 26.7%(8), 40-49years of age - 6.7%(2).

Table 1: Age distribution chart

Age (in years)	Frequency	Percent
<19	4	13.3
20-29	16	53.3
30-39	8	26.7
40-49	2	6.7
Total	30	100.0

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
AGE	30	17	47	27.37	7.223

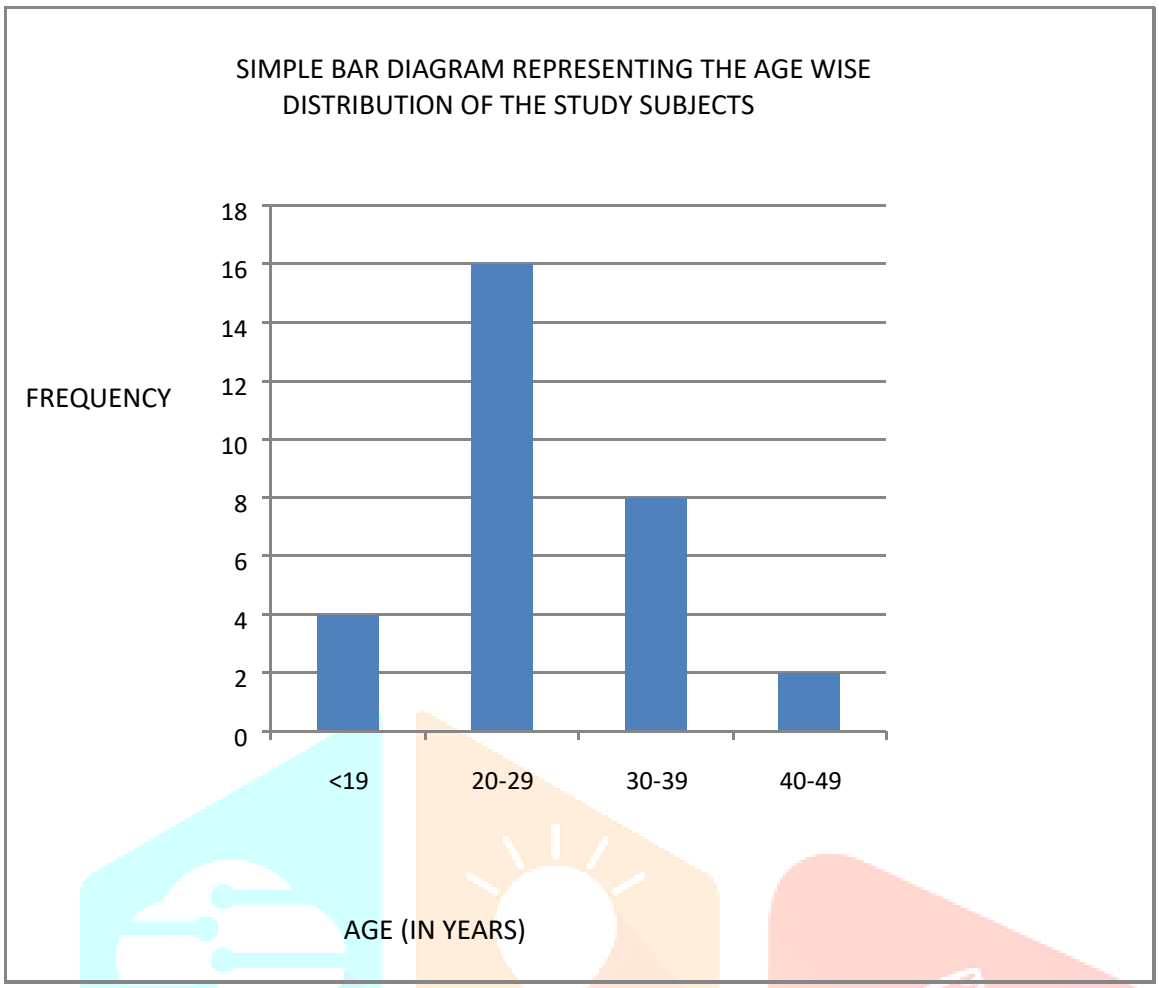


Chart 1: Age distribution chart

Table 2: Gender distribution

GENDER	NO OF CASES	%AGE
MALE	28	93.33
FEMALE	2	6.66
TOTAL	30	100

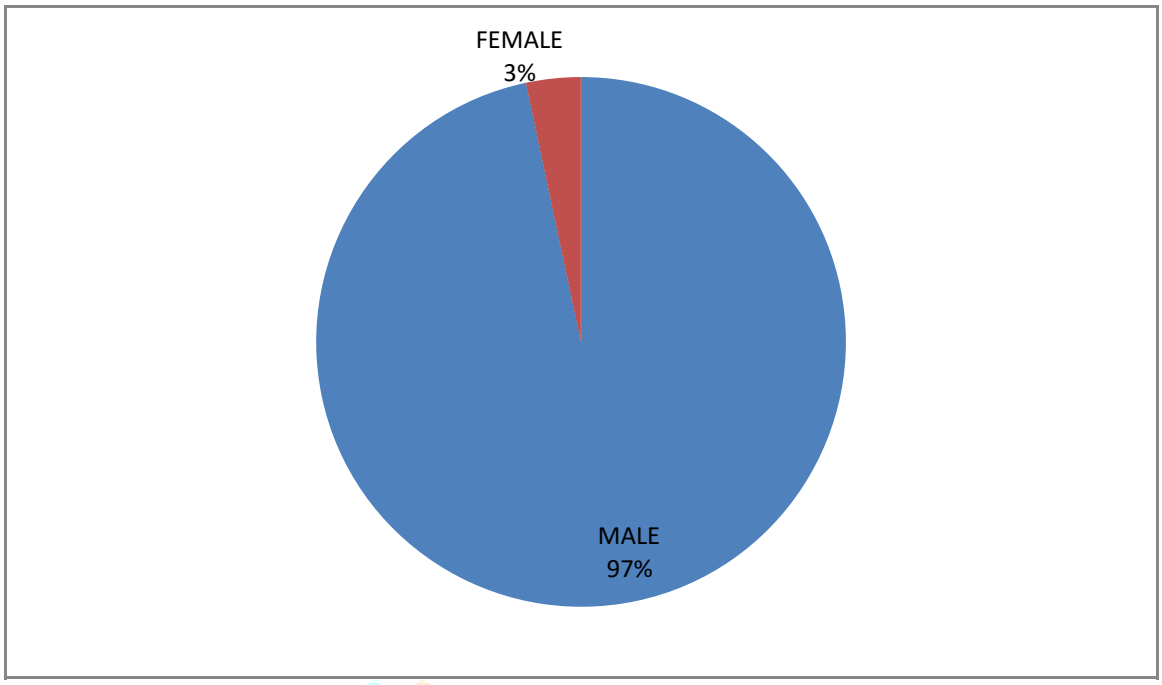


Chart 2: Gender distribution

Side Involved

86.7% (28) of the subjects were affected on the right and 13.3%(4) were affected on the left.

Table 3: Side Involved

Side	Frequency	Percent
RIGHT	26	86.7
LEFT	4	13.3
Total	30	100.0

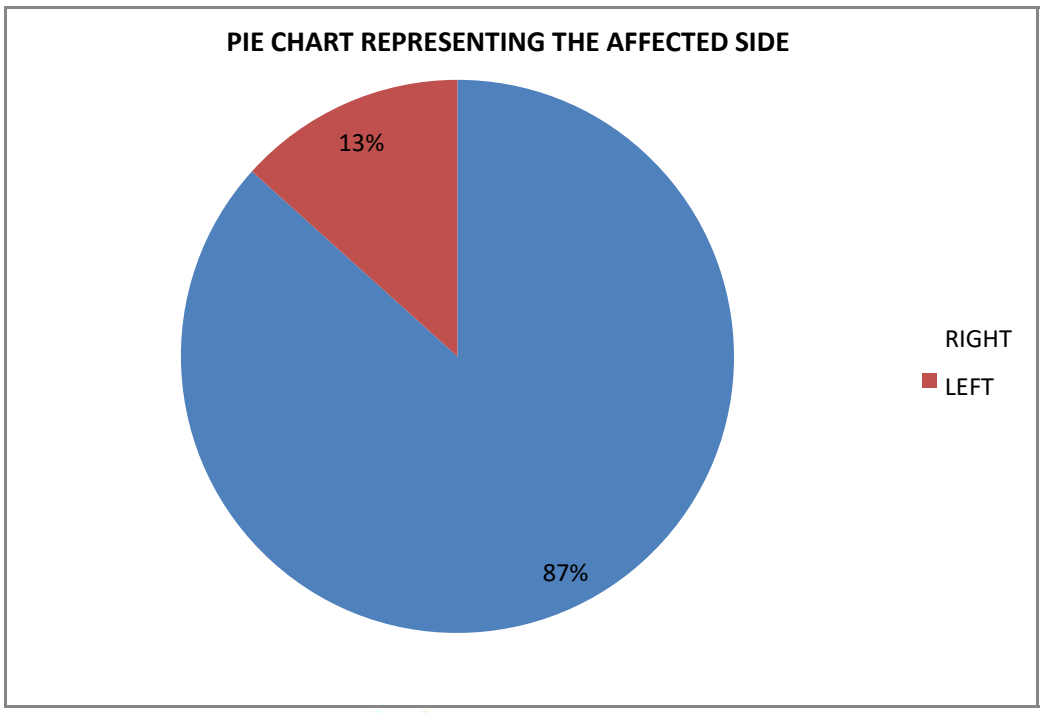


Chart 3: Side Involved

Types of Surgery perfomed

50% (15) of the patients underwent an Arthroscopic Bankarts repair and the remaining 50%(15) underwent an Open Laterjet procedure.

Table 4: Types of Surgery perfomed

SURGERY	Frequency	Percent
Arthroscopic Bankart	15	50.0
Open Laterjet	15	50.0
Total	30	100.0

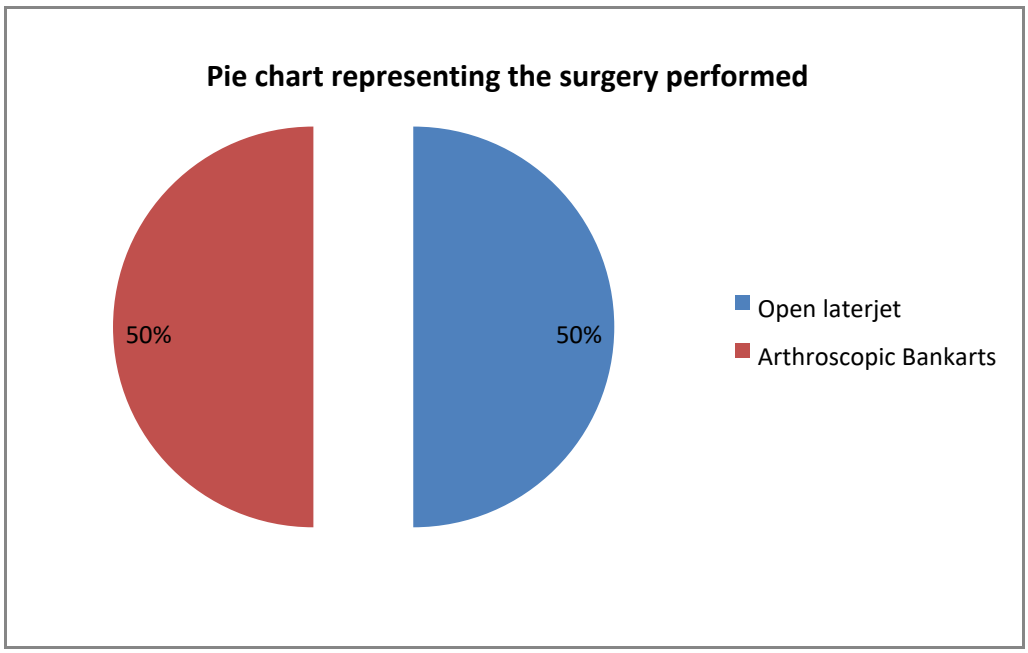


Figure 4: Types of Surgery perfomed

Glenoid Index

63.3% (19) of the patients had a glenoid index of more than 0.75 and 36.7%(11) .

Table 5: Glenoid Index

GLENOID INDEX	Frequency	Percent
Valid <=.75	11	36.7
>.75	19	63.3
Total	30	100.0

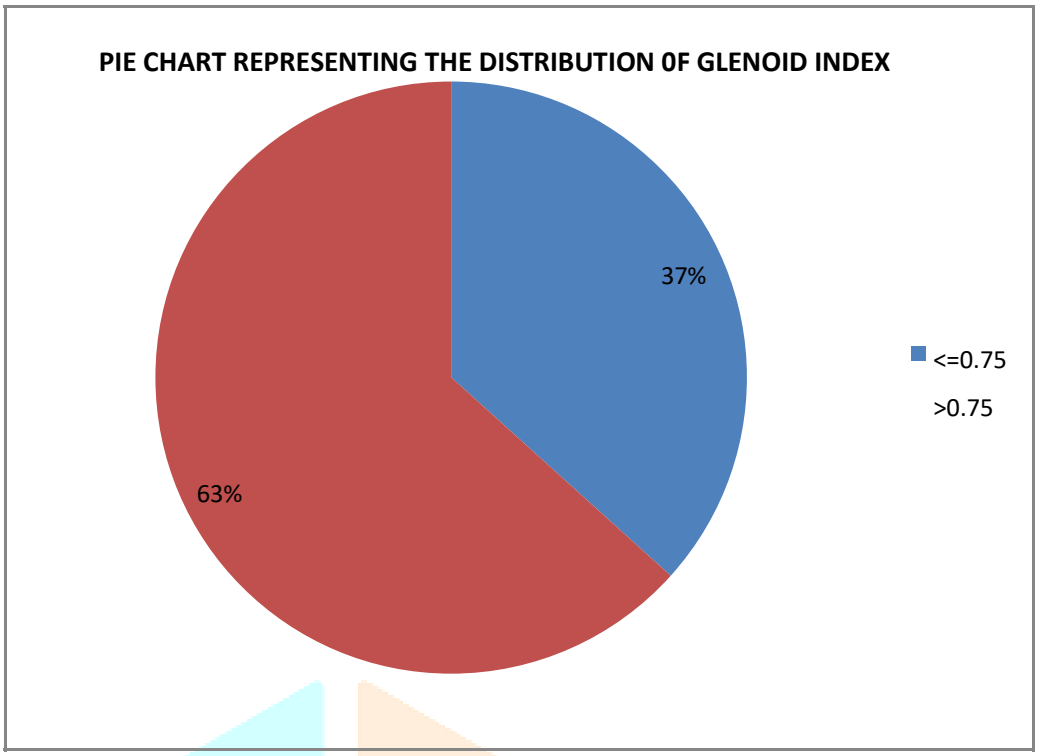


Chart 5: Glenoid Index

Group Statistics

	GROUP	N	Mean	Std. Deviation	Std. Error Mean
W2	OPEN LATERJET	14	2.268	.9029	.2413
	ARTHROSCOPIC	16	1.831	.8948	.2237
W2’	OPEN LATERJET	14	3.1986	1.66556	.44514
	ARTHROSCOPIC	16	1.9806	.96239	.24060
GI	OPEN LATERJET	14	.6836	.09476	.02533
	ARTHROSCOPIC	16	.8886	.04603	.01151

Ranks

	GROUP	N	Mean Rank	Sum of Ranks
W2	OPEN LATERJET	14	17.64	247.00
	ARTHROSCOPIC	16	13.63	218.00
	Total	30		
W2’	OPEN LATERJET	14	19.57	274.00
	ARTHROSCOPIC	16	11.94	191.00
	Total	30		
GI	OPEN LATERJET	14	8.43	118.00
	ARTHROSCOPIC	16	21.69	347.00
	Total	30		

W2 (P>0..05 NON SIGNIFICANT)

W2 ’(P<0.05 SIGNIFICANT DIFFERENCE IN W2 ’BETWEEN 2 SURGERIES PERFORMED

GI (P<0.001 VERY HIGH SIGNIFICANT DIFFERENCE IN G INDEX BETWEEN THE 2 SURGERIES PERFORMED

Percentage bone loss

63.3% (19) had a percentage bone loss of less than 25% and 36.7%(11) had a percentage bone loss of more than 25%.

Table 6: Percentage bone loss

	Frequency	Percent
<=25%	19	63.3
>25%	11	36.7
Total	30	100.0

Post imaging surgery

11 patients with a GI of less than 0.75 and 4 patients with a GI of more than 0.75 underwent an Open Laterjet procedure(73.3%) 15 patients with GI more than 0.75 underwent an Arthroscopic surgery.

Table 7: Post imaging surgery

			SURGERY_PERFORMED		Total
			Open Laterjet	Arthroscopic Bankarts	
GLENOID CODED	<=.75	Count	11	0	11
		%	73.3%		
	>.75	Count	4		
		% within			
Total		Count			
		%	100.0%	100.0%	100.0%

Table 8: Surgery Performed to the predicted surgery Crosstabulation

			predicted surgery		Total
			open laterjet	arthroscopic	
SURGERY PERFORMED	open laterjet	Count	11	4	15
		%	73.3%		
	arthroscopic	Count	0		

Total	%			
	Count			
	%	36.7%	63.3%	100.0%

Very highly significant. 73.3 % of the open laterjet surgery performed were predicted for open laterjet. P<0.001 Hence vhs association was found between the surgery performed and surgery predicted

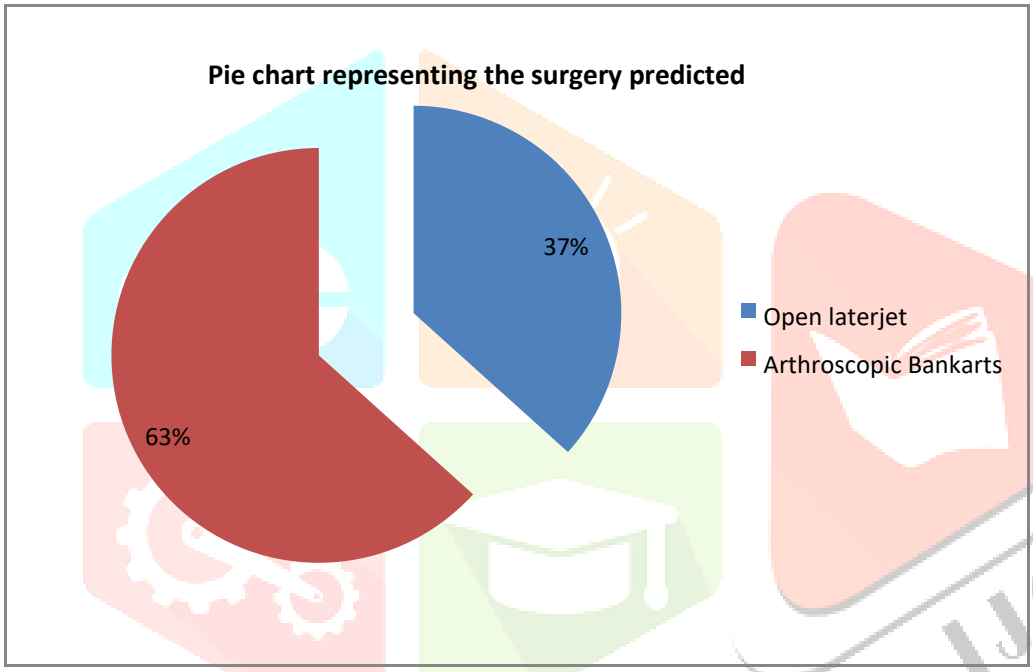


Chart 6: Pie chart representing the surgery predicted

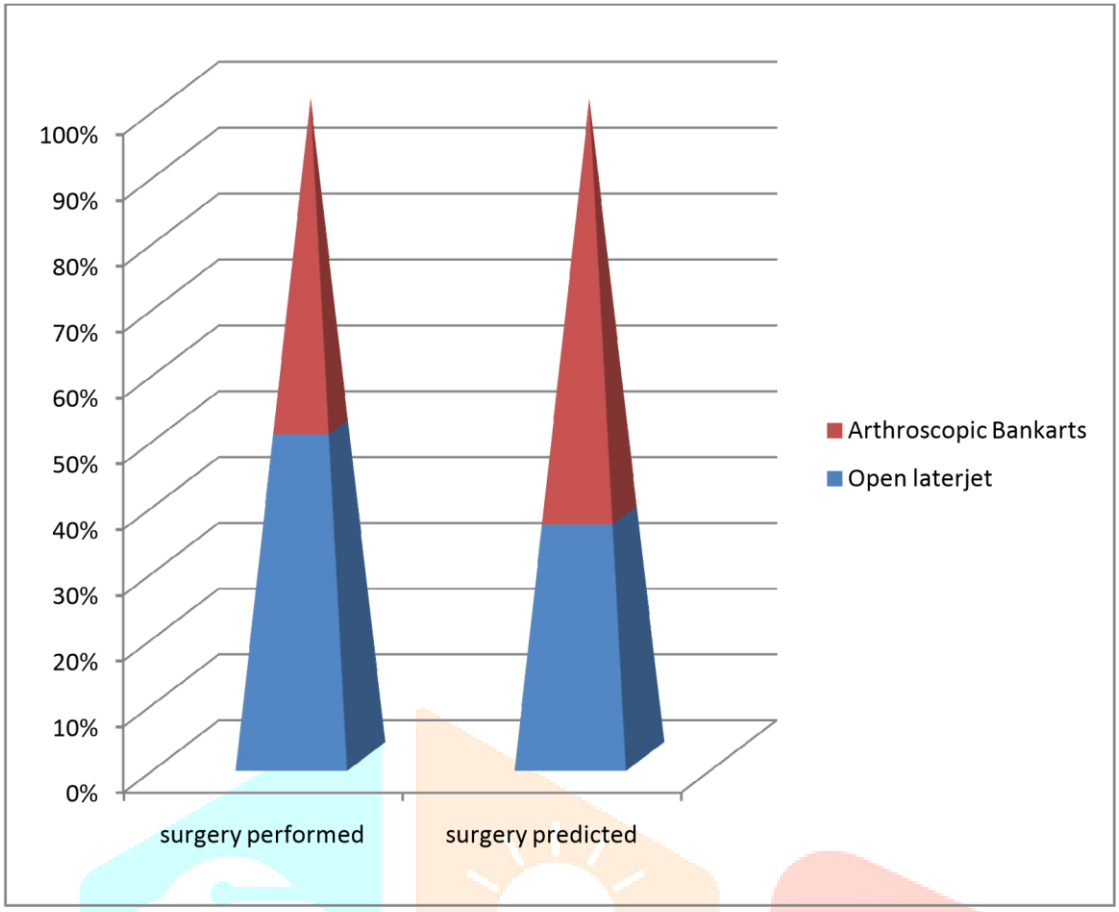
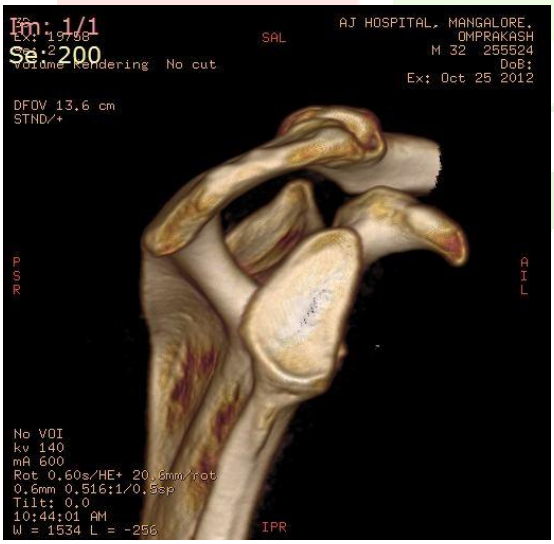
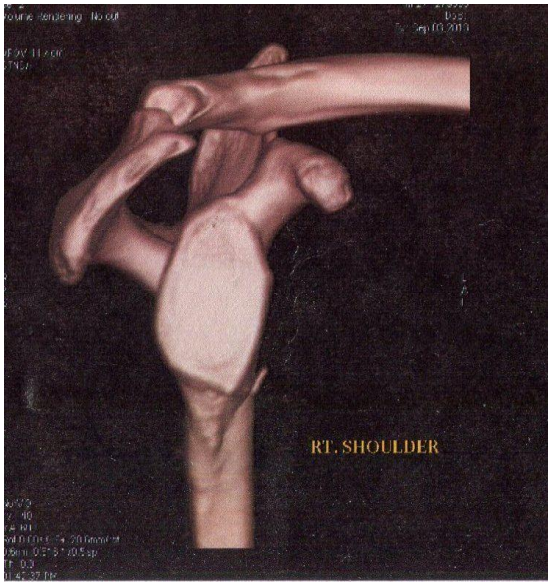


Chart 7: Component bar diagram representing the surgery performed and predicted





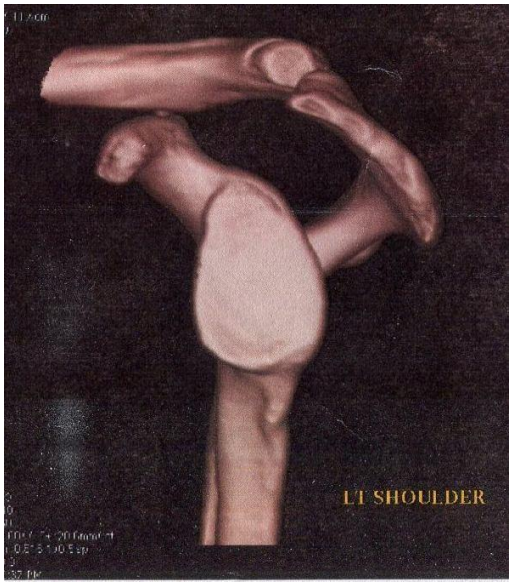


Fig 3.a- 3D reconstruction of affected side showing bone loss of about 13 %

Fig 3.b- glenoid showing normal contour

3.c-3D reconstruction of the affected side showing bone loss of about 23%

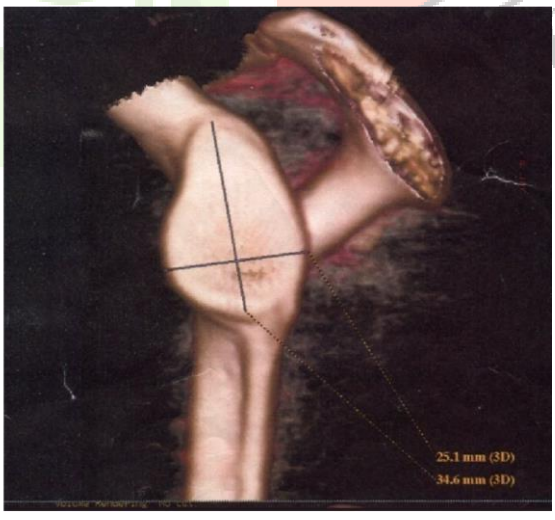
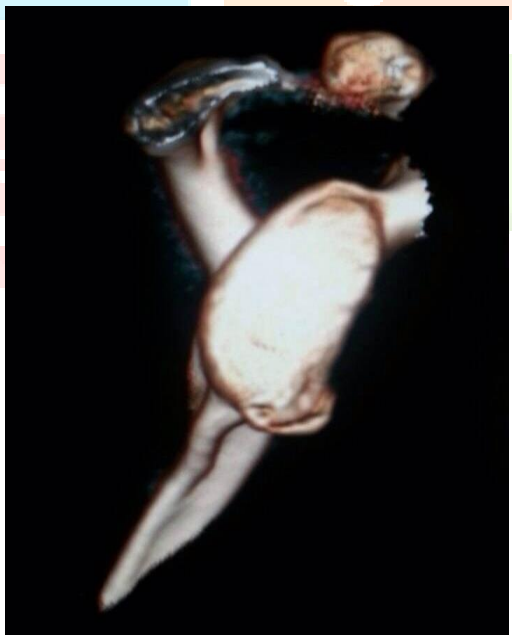


Fig d: 3D reconstruction of the glenoid showing a normal contour

Fig e: 3D reconstruction of the affected side showing bone loss of about 11%

Fig f: 3D reconstruction of the glenoid showing a normal contour

Fig g: 3D reconstruction of the affected side showing severe bone loss of about 27%



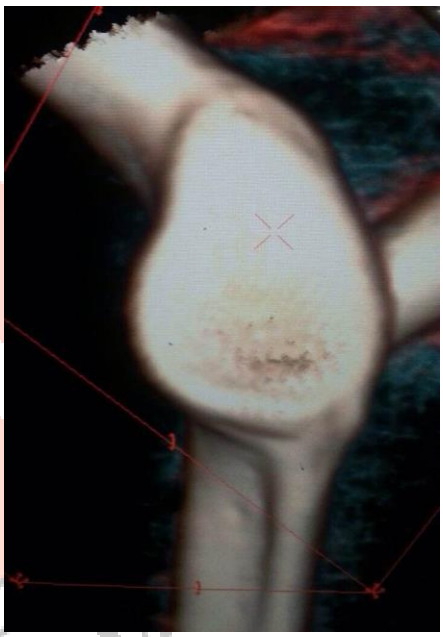


Fig h:3D reconstruction of the glenoid showing a normal contour

Fig i: 3D reconstruction of the glenoid showing fracture showing the inferior

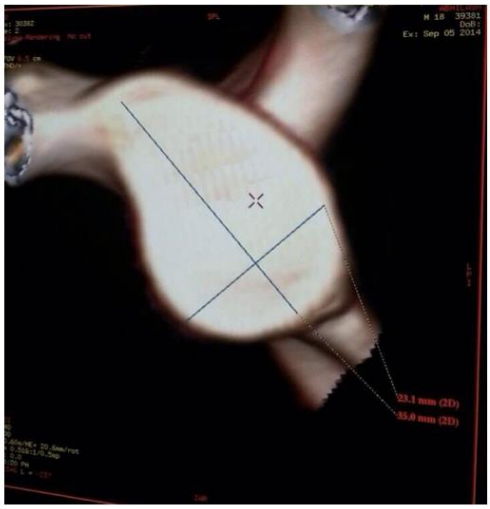


Fig j: 3D reconstruction of the glenoid showing a normal contour aspect

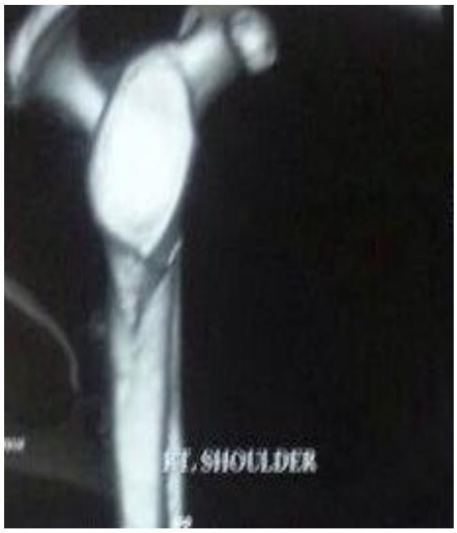


Fig k: 3D reconstruction of the affected side showing severe boneloss

Fig l: 3D reconstruction of the glenoid showing a normal contour of about 28%

DISCUSSION

In this study, indicators of bone loss was evaluated using 3-D CT only, as bone margins are easily identifiable with 3-D imaging.

Defect in the glenoid length measurements were the most accurate with 3-D CT due to clearly demarcated bony endpoints at the start and end of each defect. Although, selecting anatomic landmarks for height and width measurements was more challenging due to natural irregular, nonplanar surface of the glenoid fossa at its most superior and inferior aspects.

This prospective study was carried out in 30 patients who were referred with unilateral recurrent shoulder dislocation from the Department of Orthopedics in MVJ MC & RH. The patients had more than or equal to 3 episodes of shoulder dislocation.

All the patients underwent CT scan with additional scanning of opposite shoulder joint for comparison.

Patients were evaluated for Glenoid Index & percentage bone loss and were subsequently subjected to Arthroscopic surgery or Open Bankarts repair accordingly.

Although patients of all age groups were added in this study, most of the patients in our study belonged to the age group of 20-29yrs (53%) with a mean age of 27.37 and standard deviation of 7.233.

James .F. Griffith et[13] al have shown in their study that recurrent shoulder dislocation is more common in younger patients, with further dislocation occurring in 80% of those younger than 20 years, 60% of those 20–40 years old, and fewer than 15% in those older than 40 years. This study also observed that, Hill-Sachs deformity was not more common (p=0.21) but was more severe (p = 0.008) in recurrent than in single dislocations. A weak positive correlation was seen between glenoid bone loss and increasing severity of Hill- Sachs deformity (r = 0.24, p = 0.03). In this study, 14 of the 30 patients had a Hill- Sachs deformity.

In this study, most of the patients had right shoulder involvement (86.7%) compared to the left (13.3%).

Out if 30 patients 8 patients had fracture of the interior glenoid.

In our study of 30 patients, 11 patients(36.7%) were calculated to have a percentage bone loss of more than 25% and 19 patients(63.3%) had a loss of less than 25%.

In a study conducted by Tai-Yuan Chuang et al, 13 out of 25 patients underwent an open Latarjet procedure and 12 patients underwent an arthroscopic Bankart repair. Based on the procedural diagnostic benchmark of 0.75 for the glenoid index, 12 (92%) of the 13 patients who underwent an open Latarjet procedure and all 12 of the patients who underwent an arthroscopic Bankart repair were correctly classified, so that a total of 24 (96%) of 25 procedures were accurately predicted (Fisher exact test; $P < .001$)

In our study 19 out of 30 patients were calculated to have Glenoid index of more than 0.75(63.3%) and 11 patients of Genoid index of less than or equal to

0.75(36.7%).

15 patients out of 30 (50.0%) underwent an Open Laterjet procedure and 15 patients (50.0%) underwent Arthroscopic Bankarts repair based on the imaging findings and results and pre-surgical evaluation.

11 patients out of 30 had a glenoid index of less than or equal to 0.75. The surgery performed for all these 11 patients was an Open Laterjet (100%)

19 patients out of 30 had a glenoid index of more than 0.75. It was observed that among them 15 patients underwent an Arthroscopic Bankarts repair (78.9%) and the remaining 4 patients underwent an Open Laterjet procedure (21.1%).

Hence, It was observed that there was VERY HIGH STATISTICAL SIGNIFICANCE with $p<0.001$

SUMMARY AND CONCLUSION

This prospective study was done to quantify bone loss with surgical and CT correlation in unilateral shoulder dislocation.

This study was carried out at the Department of Radiodiagnosis and Imaging ,MVJ MC & RH.

All the 30 patients with more than 3 episodes of unilateral shoulder dislocation were subjected to CT of bilateral shoulder joint and later surgery, including both genders and all ages. Most of the patients belonged to the age group of 20-29yrs of age with the mean age of 27.3.

Out of 30, 28 patients were males ,and 2 patients were females.

Detailed clinical history of the patients was obtained.

Right shoulder was found to be more commonly involved.

Majority of the patients had a bone loss of less than 25% (63.3%) and hence Glenoid indices of less than or equal to 0.75(63.3%).

Of the 30 patients included in this study, 15 patients (50.0%) underwent an Open Laterjet procedure and 15 patients (50.0%) underwent an Arthroscopic Bankart repair.

Based of the benchmark of 0.75 for the glenoid index, 11 of the 30 patients (73.3%) underwent an Open surgery had glenoid index of more than 0.75(63.3%) and going retrospectively were predicted to do well with an Open Laterjet procedure for that value.

73.3 % of the open laterjet surgery performed was predicted for open laterjet. P<0.001, hence very high significance difference was found between the surgery performed and surgery predicted

19 of 30 patients that were predicted to have done well with an Arthrscopic Bankart repair, only 15 patients (78.9%) underwent the Arthroscopic procedure and the remaning 4 patients (21.1%) underwent an Open surgery. The glenoid indices in these four patients were more than 0.75 however, we believe that in these patients, the CT scan did not accurately show the glenoid bone loss because of a technical or artifactual problem with the scan.

To conclude, Glenoid index as calculated from the 3-D CT scan accurately predicted the surgery required to the surgery performed when compared retrospectively. The 3-D CT scan can therefore be used by surgeons as an additional diagnostic tool for preoperative planning and patient counseling.

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