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A Prospective Clinical Study of Surgical Management of Proximal Humeral Fractures

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Abstract:
Background*: Treatment of proximal humerus fractures has been the subject of much controversy and confusion. This is because of the complexity of these injuries, fracture displacements are difficult to see without careful radiographic views and associated soft tissue injuries: Our prospective study has evaluated the functional results of the methods of surgical management of displaced fractures of proximal end of humerus.*
Materials & Methods*: 20 patients with displaced fractures of proximal humerus in adults undergone surgical management. Patients were followed from 6 weeks – 15 months on OPD basis with radiological , clinical & functional evaluation.*
Results*: The most common type observed in our series was three part fracture accounting for 12 of 20 patients (60%). At the end of clinical and radiological union and full functional recovery the results were evaluated by Neer's score. Of the 20 patients 3(15%) had excellent results, 9 (45%) had satisfactory results, 6 (30%) had unsatisfactory results and 1(5%) was a failure. 1 patient expired during follow up due to medical problems .*
Conclusions*: Clinical evaluation, obtaining proper radiological views, age of the patient and activity levels holds the key for realistic approach in the management of fractures of proximal humerus. Anatomical reduction is an essential feature in these fractures. Open reduction and internal fixation with buttress plate as well as pinning has given good results.*
Key-words: *Buttress plate, Functional evaluation ,Neer's score, Proximal humerus fractures ,Surgical management.*

I. Introduction

Life is Movement, Movement is life.[1] The fast pace of modern Life, acceleration of travel increases the number of fractures. The proximal humerus fractures results from drawbacks of the fast life and violence.[2] It consists of 2% to 3% of upper extremity fractures, incidence to be about 73 per 1,00,000 population with three fourths occurring after the age of 60 years and women out numbering men. Fractures of proximal humerus account for 30-40% of all humeral fractures.80% of the proximal humeral fractures are undisplaced , minimally displaced and usually treated non-operatively generally resulting in satisfactory outcome. Remaining 20% of fractures are significantly displaced and more difficult to manage. Fixation objectives are accompanied with a thorough understanding of anatomical considerations, fracture personality, operative indications, surgical exposure and fixation techniques.[3][4][5][6][7][8]

Treatment of proximal humerus fractures has been the subject of much controversy and confusion. This is because of the complexity of these injuries, fracture displacements are difficult to see without careful radiographic views and associated soft tissue injuries. Further, there has always been diversity of opinion about the care of shoulder fractures, with frequent controversies and lively debate, further more even good anatomical results achieved at operative repair may lead to poor results unless there is meticulous post operative rehabilitation, which can be more challenging in the shoulder than operative technique.[3][4][9]

80% of proximal humerus fractures are minimally displaced and of the remainder only a few are severe fracture-dislocations, about which much debate is centered. So with this background the title for this study was chosen as it was essential to know the outcome and results of surgical management of proximal humeral fractures.

II. Aims And Objectives

1. To study the methods of surgical management of fractures of proximal end of humerus.
2. To evaluate the results of this study with respect to fracture union and restoration of shoulder function.
3. To evaluate fracture union and complications.

III. Materials And Methods

This prospective study was done at our institution from June 2003 to July 2005. The protocol was approved by the local ethics committee and written informed consent was obtained from each patient. During this study ,20 patients with fractures of proximal humerus in adults ,that is the fractures involving surgical neck, tuberosities greater and lesser, anatomical neck and head splitting fractures were selected. Exclusion criteria were fractures in children, fractures in osteoporotic bones and compound fracture.

Most of the patients were brought to the casualty or admitted through out patient basis. History was taken by verbal communication; clinical examination both local and systemic was done, careful local examination of skeletal system and soft tissue injuries was done. Later radiological examination routine AP view and trauma series view that is scapular AP and lateral and axillary views were done to analyze fracture anatomy, classify and plan the mode of treatment. Arm was immobilized in U slab and arm sling.

Fractures of the proximal humerus are most commonly classified with use of system introduced by Neer in 1970. Fractures are classified by evaluating displacement of the four principal fragments head, shaft, greater tuberosity and lesser tuberosity. [10][11]

Indication for **Surgical management** was

1. Failure of closed reduction in two part fractures.
2. All displaced fractures three and four Part.
3. Fracture dislocation.
4. Fractures associated with neuro-vascular injuries

Once the general condition of the patient was stabilized pre- operative planning and baseline investigations were done. Once patient's general condition stabilized operative fixation was done, open reduction and internal fixation was done within 8-20 days .Patients were posted for surgery under general anaesthesia ,open reduction and internal fixation or percutaneous pinning of proximal humeral fractures or hemi arthroplasty were done. Through delto- pectoral approach open reduction and internal fixation with buttress plate or cloverleaf plate or cancellous screws or K-wires was done.

Post-operatively limb is immobilized in arm pouch, Mobilization was started in the second week with pendulum exercises as per patient's tolerance. Immediate post-op X-Rays were done ,routine A-P and scapular view to assess the reduction of fracture and stability of fixation. Suture removal was done on 10^{th} day. Patients were discharged with arm pouch and advise to continue pendulum exercises. Patients underwent rehabilitation as per protocol .

Patients were followed from 6 weeks -15 months on OPD basis at intervals of 6 Weeks, 12 Weeks, 6 Months ,12 months & 15 months. During this period in each visit clinical evaluation of wound healing, pain, shoulder function and range of movements were assessed and recorded. Anatomy of the fracture was assessed by radiographs. Fractures were assessed for clinical and radiological union. Clinically fracture was consider united when there was no complaints from patients like residual pain, sense of insecurity, no tenderness, at the fracture site or full function of shoulder. Radiologically fracture was regarded as united when there is no visible fracture line. . Results were evaluated by the use of Neer's shoulder score based on pain, function, range of motion and anatomy for each case assessed and recorded.

IV. Observations And Results

In our study all cases were closed type of proximal humeral fractures.

Age group: In our series of twenty patients, four were in the age group of 21-30(20%) three in the age group of 31-40(15%), four in the age group of 41-50 (20%) seven in the age group of 51-60 (35%) and two were in the age group of 61-70(10%).

Sex incidence :In our study, seventeen out of twenty (85%) were males and three (15%)were females.

Mode of injury :The most common observed in our series was road traffic accident. It accounted for ten of twenty patients(50%).The next common cause was history of fall accounting for nine of twenty patients (45%)and one patient had a history of assault(5%).

Type of fracture :The most common observed in our series was three part fracture accounting for twelve of twenty patients (60%).The next common being two-part fracture accounting for five of twenty patients (25%).The fracture dislocation was observed in one patient(5%). Fracture dislocation was observed in two out of twenty patients (10%).

In our series the majority were 3 part fractures (12 patients) ,2 patients with 2 part fractures, and 1 with fracture dislocation underwent open reduction and internal fixation with buttress plate. 3 patients with 2 part fractures with failed closed reduction underwent percutaneous pinning with K-wire and cancellous screws. 1 patient with anatomical neck fracture & one with four part fracture underwent hemi arthroplasty..Most of the cases were approached by delto pectoral approach except only in 3 cases were percutaneous pinning was done. Fractures was anatomically reduced and fixed with "T' Buttress plate or Cloverleaf plate with 4.5 mm cortical screws and 6.5mm cancellous screws for fifteen patients. Two patients underwent hemiarthroplasty with Neer's prosthesis. Three patients underwent fixation with K-wires and cancellous screws. Fixation rigidity was checked on table. Patients were mobilized in the arm pouch.All patients were encouraged pendulum exercises in the second week. Sutures were removed on the 10^{th} post operative day.

The average follow up duration has 11.6 months. Range- (10-15months). The average time taken for clinical union was 12.8 weeks (11-16weeks) and for radiological union15.6 weeks (16 to 22 weeks).

Range Of Motion:

At the end of full functional recovery all patients assessed by Neer's shoulder score had restriction of abduction, forward flexion and external rotation. The average loss of abduction was 67°, forward flexion 60°, external rotation was 17°, internal rotation 15°, extension 12°. The average range of movements observed was abduction 113° , forward flexion 120°, extension 33°, external rotation 28°, internal rotation 54.5º.

Evaluation Of Results By Neers Shoulder Score:

At the end of clinical and radiological union and full functional recovery the results were evaluated by Neer's score. Of the twenty patients three (15%) had excellent results, nine (45%) had satisfactory results, six (30%) had unsatisfactory results and one (5%) was a failure. One patient expired during follow up due to medical problems.

Complications:

During the follow up period four patients had post-operative infection(20%) , six patients had shoulder stiffness(30%) and one patient had implant loosening(5%) and had to undergo revision in which case cementing was done.. There were no incidences of non-union, malunion & osteonecrosis of the proximal humerus.

V. Discussion

Proximal humeral fractures constitute 4-5% of all fractures of long bones. It constitutes for 2-3% of the fractures of upper limb. 75% of these fractures are seen in elderly. 80-85% of these fractures are amenable to conservative treatment remaining 15-20% are significantly displaced and require some type of internal fixation .[4][9][12]

In this study at our institution, 20 patients with fractures of proximal humerus were managed by open reduction and internal fixation through the delto pectoral approach .Out of the 20 patients, 15 were treated with buttress plate, 3 with K.wires and cancellous screw and 2 underwent hemiarthroplasty.

Indications for surgery in our series were –

1. Failure of closed reduction in two part fractures.
2. All displaced fractures three and four part (>1 cm displacement and > 45° angulation).
3. Fracture dislocations.

Age Incidence

The average age incidence in our series was 46.4 years, which was consistent with the age incidence in studies done by Neer was 55.3 years.[9][10] In other studies the average age was 52 year.[13] In our series 11 out of 20 patients were below the age of 50 years and hence the average age incidence was 46.4 years in our series.

Sex Incidence

Regarding sex incidence study of literature reveals predominance of proximal humeral fractures in females in an elderly age group.[3] Studies also reveal that male to female ratio being 1:0.8 [13]and 1:1.3 [6] .In our series the male to female ratio is 1:0.2, 17 among 20 patients were males. The reason for high incidence of males in our series being that the majority of the cases, 11 out 20 were within the age of 50years and 8 among them were less than 40 years of age. These fractures of proximal humerus have bimodal presentation with adolescents and younger middle age who are more prone for high velocity injuries most common among males forming one group and later these fractures are seen in elderly patients(>50 years) in which cases they are osteoporosis related most often seen in females.[2]

Mode Of Injury

The mode of injury commonly observed in our series was road traffic accidents accounting for 10 (50%),9 (45%) patients had an history of fall and 01(5%) had an history of assault. These observations was found to be consistent with the studies in literature which revealed 19(45%) road traffic accidents,20(50%) history of fall and 01(5%) history of assault out of the forty cases studied[6][13] In another study 12(75%) had road traffic accident and 04(25%) had history of fall in a series of 16 cases studied. [6]

Type Of Fracture

The study of type of fracture in our series revealed 7(35%) were 2 part fractures, 12(60% were 3 part fractures and 01 (5%) was a 4 part fracture. In studies done by Neer [9,10] in a series of 117 patients studied 31(26.5%) were 2 part fractures, 43(36.8%) were 3 part fractures and 43(36.8%) were 4part fractures. In another study of 40 cases 20(50%) were 2 part fractures, 16(40%) were 3 part fractures and 4(10%) were 4 part fractures indicating that the incidence of type of fracture is nearly consistent with the studies in literature.[13]

Modes Of Internal Fixation

Different modes of internal fixation was employed in our series of 20 patients 15(75%) underwent open reduction and internal fixation with buttress plate, 03(15%) underwent fixation with K-wires and cancellous screws and 02(10%) underwent prosthetic replacement. In study of literature 117 cases studied by Neer 43(36.8%) underwent open reduction and internal fixation with buttress plate and tension band wiring,43(36.8%) of 4 part fractures and selected 3 part fractures underwent prosthetic replacement.[9,10.] In another series of 15 patients 14(93.3%) underwent internal fixation with K-wires/cancellous screws and only one underwent fixation with AO buttress plate.[6]

Follow Up

All fractures united with in one year the mean follow up period was 11.6 months during which clinical evaluation was done for clinical union, radiological union and functional assessment was done. All fractures revealed clinical union at 12.8 weeks (11-16weeks). Like wise radiological union was assessed which was noticed 15.6weeks (16-22 weeks). Literature reveals the average clinical union time for minimally invasive procedure being 8 -10 weeks and for OR & IF with plates 12-14 weeks.[6][7][13]

Range Of Motion

Range of motion at the end of full follow up period was assessed regarding the movements of abduction, forward flexion, internal rotation, external rotation and extension. In our series the average values for the above shoulder movements were abduction 113º , forward flexion 120º, Internal rotation 54.5º, external rotation 29º and extension 33º. These results compared with the studies on percutaneous fixation are satisfactory.[6][7] The reasons for difference in observed values are probably due to poor surgical technique, increased soft tissue handling in open reduction and internal fixation and lack of awareness or understanding the importance of rehabilitation programme in our patients.

Results

The results in our series of patients were evaluated with the use of Neer's criteria for different types of fixation and analyzed with other studies. In our series 15 cases of three part fractures treated with OR & IF had 01 (5%) excellent results, 08 (40%) had satisfactory results, 05 (25%) had unsatisfactory results and 01(5%) was a failure. When compared with other studies in case of Neer's 30 cases, 19 cases (63.3%) had excellent and satisfactory results .[9][10] In other study of 15 cases of 3 part fracture 14 (93.3%) had excellent and satisfactory results, all of them had underwent OR & IF with K wires/cancellous screws and one failure in this series was fixation with AO buttress plate. In Neer's series 11 cases (36.7%) was a failure compared with our series in which case we had 30% of unsatisfactory and failure results. This implies that our results with OR & IF are almost correlated with the studies in literature but improved results are seen in minimal fixation techniques.

Studies reveal that results of percutaneous pinning are more superior to OR & IF regarding functional outcome. In 48 cases studied 91.6% of the cases had excellent (70.8%) and satisfactory (20.8%) results with 04 (8.3%) failures.[14] In our series two patients underwent percutaneous pinning both had excellent results.

Results pertaining to prosthetic replacement , studies reveal that prosthetic replacement is of chores in 4 part fracture and selected 3 part fracture in elderly. Neer studied 43 cases of which 5 (11.6%) had excellent ,34 (79%) had satisfactory results only 4 had unsatisfactory and failure. [10]In another study of 70 patients 31(44.3%) had excellent results, 22(31.4%) had satisfactory results and 17 (24.3%) had unsatisfactory results. In our series of 20 patients 02 underwent prosthetic replacement one with anatomical neck fracture and other patient with four part fracture. We had one satisfactory result and one unsatisfactory result. The unsatisfactory results was due to implant loosening, she had to undergo revision surgery with bone cementing.

In the **overall results analyzed in our series** 60% of the patients had excellent and satisfactory results and 35% had unsatisfactory and failure outcome. This was observed to be on par with the studies in literatures [6][7][13][14].

The unsatisfactory results in our series was seen mostly in elderly patients who had metaphyseal defect and in which cases bone grafting was not done thus delaying the union time. These patients were reluctant or not compatible for rigorous rehabilitation programme. Decreased immunity status lead to infection in few of these patients resulting in unsatisfactory and failure outcome.

Complications

Complications following surgeries on proximal humerus is seen most of the time due to poor surgical technique, decreased patient compliance and lack of good rehabilitation programme. In our series 06(30%) had shoulder stiffness,04(20%) had post operative infection and 01(5%) had implant loosening. Compared to other series [7][9][10] we had stiffness in 30 % of the patients, most of these patients were elderly who were unwilling to undergo rigorous rehabilitation programme. 20% of our patients had post operative infection ,3 of them had superficial infection which subsided with systemic antibiotics but one patient had deep seated infection after discharge from hospital but reported late to hospital after 3 weeks, for whom aspiration was done and later subsided by systemic antibiotics who later developed arthritis of shoulder and accounted for failure outcome, other three patients had unsatisfactory results. One patient who underwent hemiarthroplasty had recurrent subluxation of the implant due to implant loosening, after 3 months she underwent revision surgery in which case the implant was reinforced with bone cement and S.S wire fixation for the tuberosity. The complications in other series seen were in a series of 117 patient studied by Neer 03 had post operative infection , 04 had malunion ,07 had non union and 08 had avascular necrosis of the humeral head .[9][10] In another series of 15 patients 2 had implant loosening and 2 had avascular necrosis of the humeral head . [7]

VI. Conclusion

In conclusion, fracture of the proximal humerus is still a debatable and controversial subject in orthopaedics.Clinical evaluation, obtaining proper radiological views, age of the patient and activity levels holds the key for realistic approach and proper surgical management of these complex fractures .

Anatomical reduction is an essential feature in these fractures. Open reduction and internal fixation with buttress plate as well as percutaneous pinning has given good results. Rehabilitation to achieve good functional recovery of the shoulder is very essential especially in middle aged and elderly individuals following any mode of fixation. With results assessed with standard shoulder scoring system of Neer's, we have achieved 60% of excellent and satisfactory results,30% unsatisfactory and 10% failure outcome.

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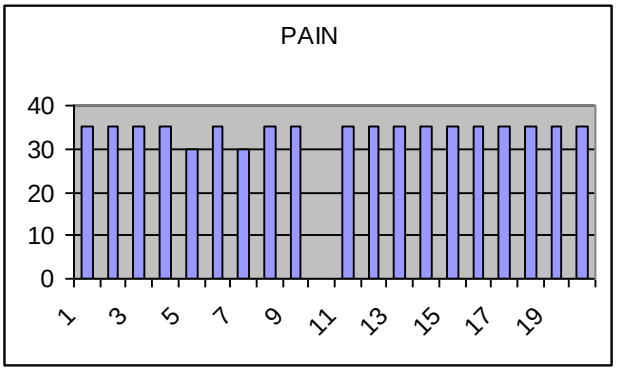
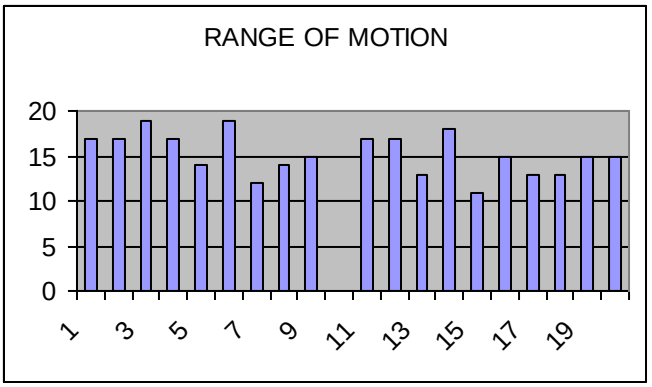
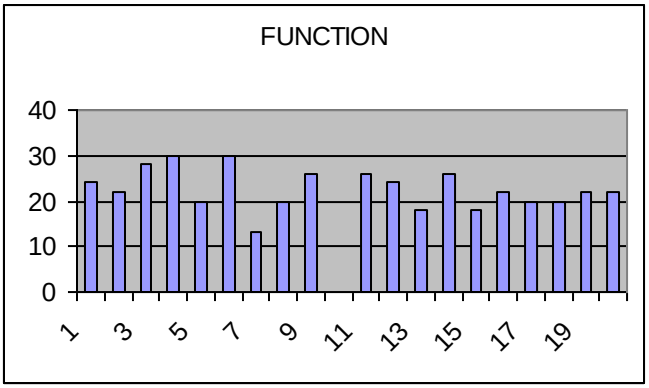
Evaluation Of Results By Neers Shoulder Score (Table -1)

Sl no.	PAIN	FUNCTION	RANGE OF MOTION	ANATOMY	TOTAL
1	**35**	**24**	**17**	**8**	**84**
2	**35**	**22**	**17**	**8**	**82**
3	**35**	**28**	**19**	**8**	**90**
4	**35**	**30**	**17**	**10**	**92**
5	**30**	**20**	**14**	**8**	**72**
6	**35**	**30**	**19**	**10**	**94**
7	**30**	**13**	**12**	**4**	**59**
8	**35**	**20**	**14**	**8**	**77**
9	**35**	**26**	**15**	**8**	**84**
10	**expired**				
11	**35**	**26**	**17**	**8**	**86**
12	**35**	**24**	**17**	**8**	**84**
13	**35**	**18**	**13**	**4**	**70**
14	**35**	**26**	**18**	**8**	**87**
15	**35**	**18**	**11**	**8**	**72**
16	**35**	**22**	**15**	**8**	**80**
17	**35**	**20**	**13**	**8**	**76**
18	**35**	**20**	**13**	**8**	**76**
19	**35**	**22**	**15**	**8**	**80**
20	**35**	**22**	**15**	**8**	**80**

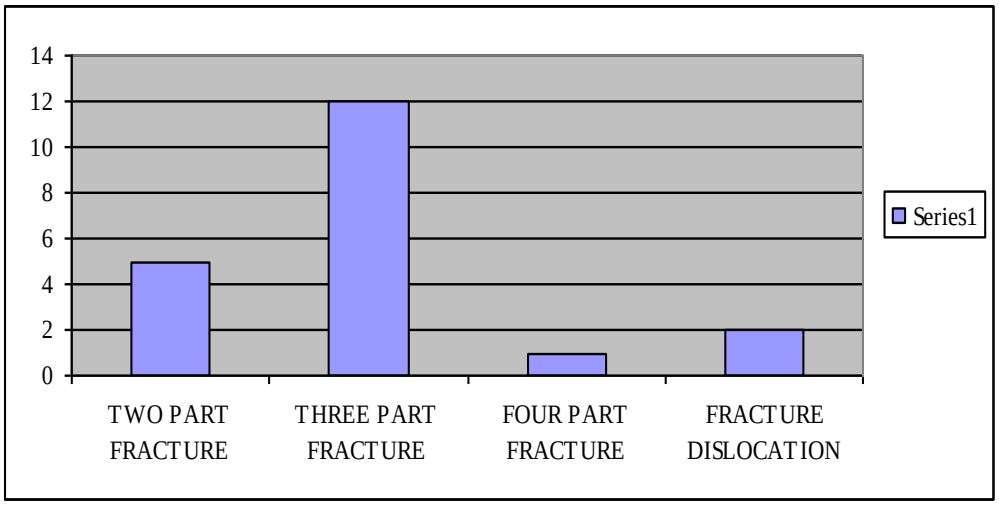






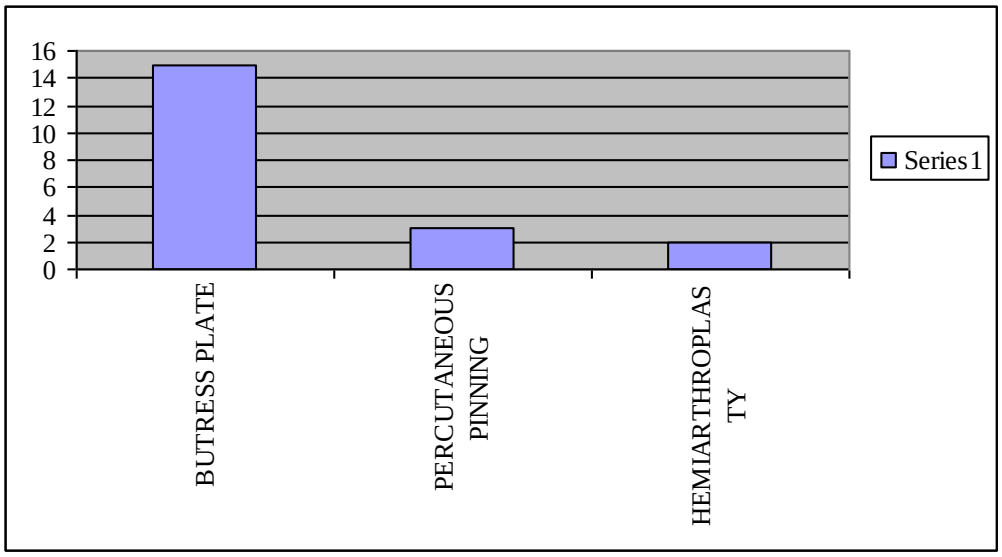
Type Of Fracture (Table -2)

TWO PART FRACTURE	05
THREE PART FRACTURE	12
FOUR PART FRACTURE	01
FRACTURE DISLOCATION	02



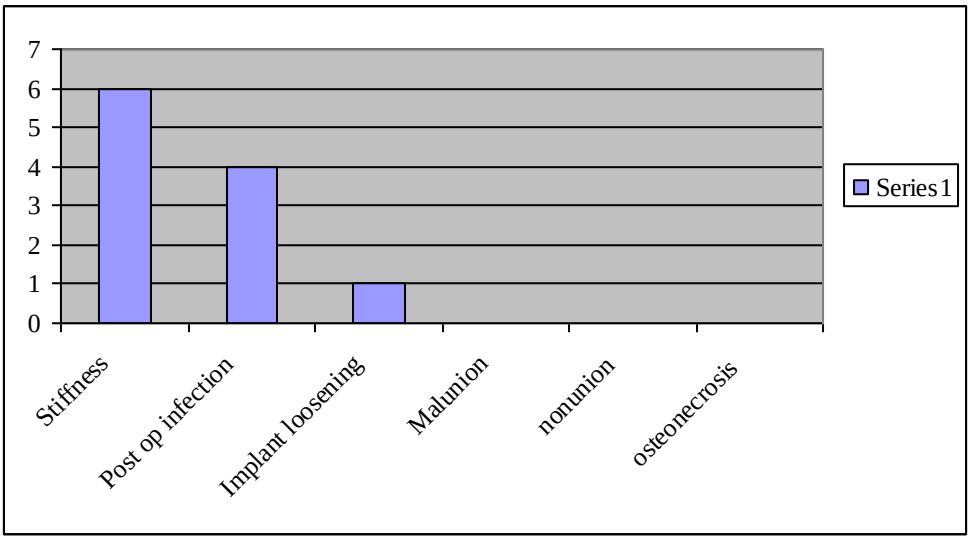
Mode Of Internal Fixation (Table -3)

BUTRESS PLATE	15
PERCUTANEOUS PINNING	03
HEMIARTHROPLASTY	02



Complications (Table – 4)

Stiffness	06
Post op infection	04
Implant loosening	01
Malunion	00
Nonunion	00
Osteonecrosis	00



Case 1

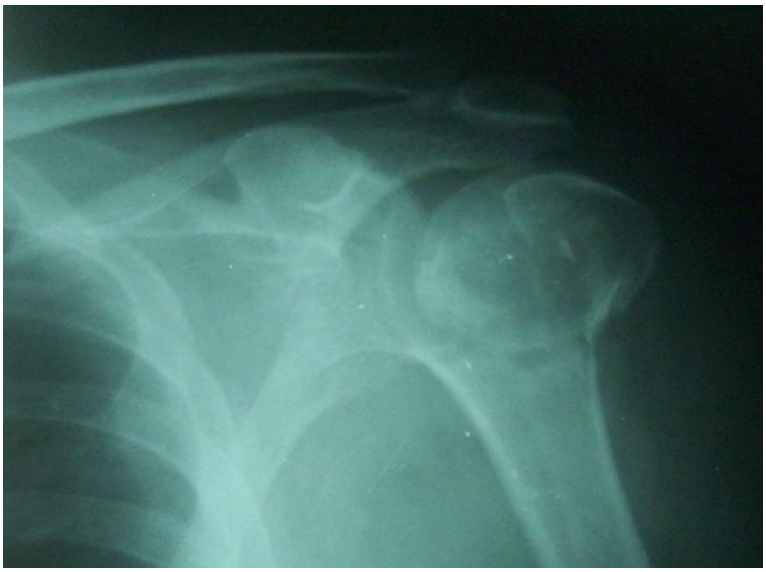


FIG 1: pre op x-ray: three part fracture

FIG 2: Post op x-ray at 6 weeks

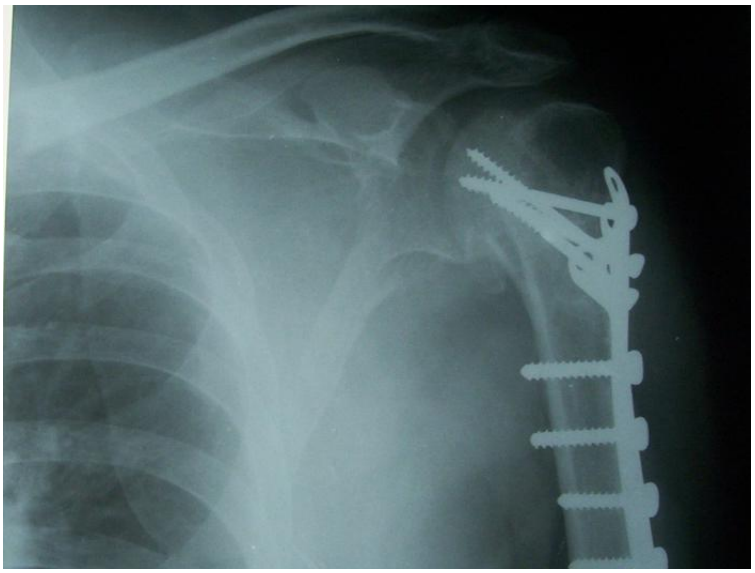


FIG 3: Follow up at 6 months

Case 2

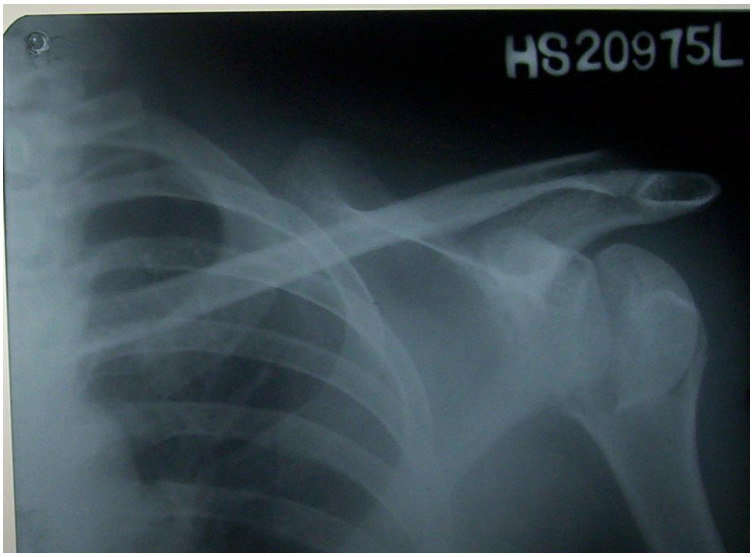


Fig 3 :PRE-OP X-Ray: anatomical neck fracture

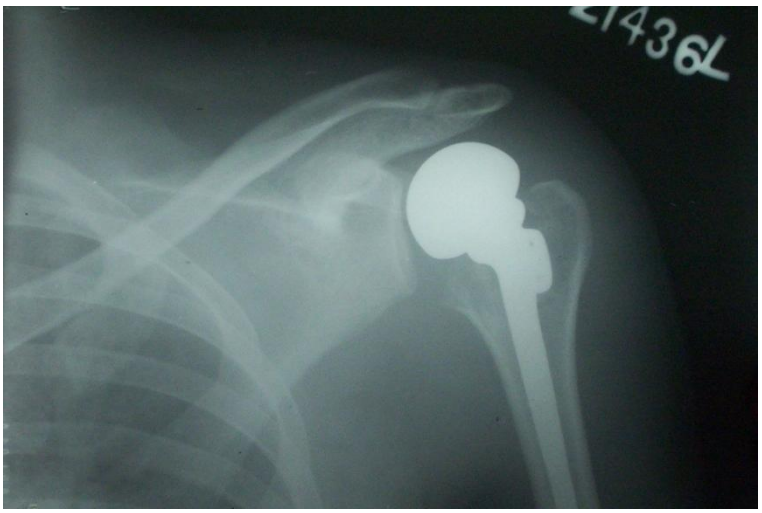


FIG 4:post op x-ray revealing prosthesis insertion

Case 3

FIG:5-Pre-op x-ray:three part fracture

FIG 6: post op x ray -Fixation with K-wires and cancellous screws