Section: Orthopedics

Original Research Article

A STUDY ON SURGICAL MANAGEMENT OF FRACTURE SHAFT HUMERUS BY OPEN REDUCTION AND INTERNAL FIXATION WITH DYNAMIC COMPRESSION PLATE

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ABSTRACT

Background: The present study is an attempt to study the advantages & disadvantages of open reduction internal fixation using dynamic compression plate with screws for fracture shaft of Humerus.

Materials and Methods: Thirty cases of fracture shaft of the humerus were treated by open reduction and internal fixation with Dynamic Compression Plate. Our aim was to treat these fractures by rigid internal fixation, early mobilisation and to assess the outcome of Dynamic Compression Plate in the treatment of these fractures.

Results: In the present study, the mean age of patients with these fractures was 40.9 years and the maximum patients were in the age group of 20-30 years. Males predominated in our study. Road traffic accidents are the main cause of these fractures followed by accidental fall. Different fracture patterns were seen in our study, 12 transverse, 8 oblique, 6 comminutted and 4 spiral. Radiological union was seen at an average of 12 weeks. Excellent results were maximum in middle third transverse and short oblique fractures which predominated in this study. The present study revealed that results were excellent in 25 cases, good in 4 and poor in 1 cases. Bad results were more often associated with compound fractures and communited fractures.

Conclusion: The present study concluded that, Open reduction and internal fixation with Dynamic compression plate for humeral shaft fracture is the fixation of choice in adults.

Keywords: Open reduction, Humeral Shaft Fractures, Dynamic compression plate, Road traffic accidents.

INTRODUCTION

In this modern age, fractures of Humerus are on an increase & the management of these fractures also forms an important part of orthopaedic management. Fractures of Humerus accounts for nearly 3% of all fractures. Unlike fractures of other bones, there is no over riding on the contrary there is a danger of delayed union or non union, as the weight of the limb will act as a distracting force. Although most of humeral shaft fractures can be managed conservatively with good to excellent results, the matter of consideration is of maintaining their alignment, length, rotations & early mobilization of the neighbouring joints, Open reduction & Internal fixation with dynamic compression plate gives following advantages:

- The reduction is done under direct vision.
- This is a method of achieving a stable fixation with almost perfect reduction.
- Good reduction is achieved & maintained as the plate is placed on the tensile side. The muscle tone provides compression at the fracture site.
- Rotatory instability is prevented.
- Cost effectiveness.
- Clean & sterile operation theaters with good antibiotics have decreased the chances of infection.
- As there is no need for C- arm the medical staff has no radiation hazards.

- The limb can be mobilized early & joint stiffness as well as muscle contractures can be minimized.

The present study is an attempt to study the advantages & disadvantages of open reduction internal fixation using dynamic compression plate with screws for fracture shaft of Humerus, analyze the results & compare with the standard studies.

Aims and Objectives

1) To clinically evaluate the

- Rate of Union.
- The functional outcome of the treatment.
- Incidence of complications like non-union, Infection, Radial nerve palsy.

2) To compare the results of my study with the works reported.

Mechanism of Injury

Humeral shaft fractures result from direct & indirect trauma. ln majority of case, they are the result of direct injury such as fall on the arm at the side or blows. it may result from indirect violence such as a fall on the elbow or hand. Extreme muscle contraction may cause fracture of the humerus. Pure compressive forces result in proximal or distal humerus fractures, bending forces, however, typically result in transverse fractures of the humerus shaft. Torsional forces result in spiral fracture patterns. The combination of bending & torsion usually results in an oblique fractures, often with an associated butterfly fragment. Greater amounts of comminution & soft tissue injury results from high energy injuries. Rarely, there may not be any displacement. The muscle forces that act on the humeral shaft produce characteristic deformities. A fracture proximal to the pectoralis major insertion results in abduction & internal rotation of the proximal fragments secondary to the pull of rotator cuff, while the distal fragment is displaced medially by pectoralis major. If the fracture is distal to the pectoralis major insertion & proximal to the deltoid insertion, the distal fragment is laterally displaced by the deltoid, while the pectoralis major, latissimus dorsi & teres major displace the proximal fracture medially. When the fracture is distal to deltoid insertion, the proximal fragment is abducted & flexed while the distal fragment is proximally displaced. Patient with humeral shaft fracture presents with history of trauma, arm pain, swelling & deformity. The arm is shortened with gross motion, localtenderness & crepitus on gentle manipulation. Neuro vascular status of the extremity must be assessed. Identification of associated injuries immediate management of life threatening injuries must be done.

MATERIALS AND METHODS

The clinical material for the study of Surgical management of Diaphyseal Fractures of Humerus in Adults by Open Reduction Internal Fixation with Dynamic Compression Plate & Screws consists of 30 cases of fresh Fractures Shaft of Humerus of traumatic etiology meeting the inclusion & exclusion criteria, admitted to Basaveshwara Medical College& Hospital, Chitradurga for a period of two years between July 2023 to June 2025.

Inclusion Criteria

- Adults above the age of l8years.
- Fresh fractures without neurological deficits.

Exclusion Criteria

- Pathological fractures.
- Malunited fractures.
- Compound fractures.
- Infected fractures.
- Ununited fractures.
- Below 18 years of age

As soon as the patient is admitted, a detailed history was taken & a meticulous examination of the patient was done. The required information was recorded in the proforma. The patient's arm radiographs were taken in the Antero-Posterior & Lateral views. The diagnosis was established by clinical & radiological examination.

In this study, diaphyseal fracture of Humerus were classified according to L.KIenerman's.[4] classification. (1966) of London, fractures of the shaft of humerus were classified depending on the level of fracture.

- Fractures of upper third.
- Fractures at the junction of upper & middle third.
- Fractures of middle third.
- Fractures at the junction of middle & distal third.
- Fractures of the lower third.

Initially the patient's injured arm is immobilized in a plaster of paris U- slab, Drugs are given to alleviate pain. All the patients were taken for elective surgery as soon as possible after necessary blood, urine & radiographic pre- operative work-up.

The patient's attenders were explained about the nature of injury & its possible complications. Patient's attenders were also explained about the need for the surgery & complications of surgery.

Written & informed consent was obtained from the patient for surgery. Medical evaluation of the patient is done after consulting the Physician. Hygiene of the skin was maintained with regular scrub with betadine. injection Tetvac is given, the affected arm with the axilla was shaved, scrubbed with savlon&betadin. The anesthetist is informed, Per-operative parenteral antibiotic (preferably Cephalosporins) are administered one hour before surgery (Post-operatively continued for 5days & then converted into oral antibiotics till the sutures are removed). The patient is shifted to the operationtheater with the x-rays & drugs.

Instruments used for Surgery

- Periosteum elevator.
- Bone Lever.
- Bone Hook.
- Loin bone holding clamp.
- Bone curette.
- Self retaining A.O. clamp.

- C-clamp.
- Plate holding clamp.
- Check-key.
- Hand piece ofthe Drill with cord. 11) Metal scale.
- Plate bendr.
- Screw driver.
- Tap.
- Depth gauge.
- Drill bit.
- Drill guide.
- Broad Dynamic compression plate.
- Narrow Dynamic compression plate.
- Cortical screws.

Pre-Operative Planning

Depending on the level of fracture, Nature of fracture, Line of fracture, Number of fragments, Approach, Type of plate (Broad or Narrow), Length of plate, Number of screws & lnterfragmentory screws all are assessed.

Operative Technique

Anaesthesia: - The patient taken up for surgery under General Anaesthesia.

Patients positioning: - The patient is placed in prone position for Posterior approach & Supine position for Antero-Lateral approach with arm on side board.

Draping: - The arm with the axilla is Scrubbed with Betadine scrub for 10 minutes, Painted with betadine solution & spirit, Draped with linen over the proposed Incision site.

Surgical Approach

Anterolateral approach(THOMPSON; HENRY)[22]:

The skin is incised in line with the anterior border of the deltoid muscle from a point midway between its origin and insertion, distally to the level of insertion, and then proceeded in line with the lateral border of the biceps muscle to within 7.5 cms of the elbow joint. The superficial and the deep fasciae are divided and the cephalic vein ligated. In the proximal part, the deltoid is retracted laterally and the biceps medially to expose the shaft of the humerus. Distal to the insertion of the deltoid, the brachialis muscle is exposed, split longitudinally to the bone and retracted subperiosteally, the lateral half to the lateral side and the medial half to the medial side. Retraction is easier when the tendon of brachialis is relaxed by flexing the elbow to a right angle. The radial nerve as it winds about the humeral shaft is protected by the lateral half of the brachialis muscle. The distal end of this approach may be carried to within 5 cm of the humeral condyles and the proximal end further proximally. The anterior aspect of the humeral shaft at the junction of its middle and distal thirds can also be approached between the biceps and brachialis muscles medially and the brachioradialis laterally. The advantages of this approach are that the brachialis muscle is usually innervated by both the musculocutaneous and the radial nerve and can thus be split longitudinally without paralysis and that the lateral half of the brachialis muscle protects the radial nerve.

Posterior approach[23]

An incision is made in the midline on the back of the arm from the tip of the olecranon upwards and deepened through subcutaneous tissue to expose the muscle belly of the triceps. To identify the gap between the lateral and long heads of the triceps, begin proximally above where the two heads fuse to form a common tendon. The interval is developed between the heads by blunt dissection, retracting the lateral head laterally and the long head of the triceps medially and split by sharply dissecting the common tendon along the line of the skin incision. The medial head of the triceps is identified and isolated which lies below the other two heads, the radial nerve runs just proximal to it in the spiral groove (middle third). Care should be taken not to bruise the ulnar nerve which lies close to the bone on the medial side. The incision can then be extended to expose the whole bone. The lateral cutaneous nerve of the arm may be seen as it escapes from under the posterior border of deltoid insertion

Which is reflected laterally. The lateral head of the triceps is split longitudinally. The bone is exposed.

The fracture identified, freshened by curetting, cleaned & approximated. The fracture fragments are Reduced & Plate is placed as assessed pre-operatively, Held with clamps. Then the plate is fixed with screws. lnterfragmentory screws are placed if necessary. The wound is closed in layers, wound is dressed. The U-slab is applied.

Post-Operative Management

- The limb is elevated over a pillow.
- The patient is encouraged to move his fingers.
- The Blood pressure, Pulse, Temperature, Soakage of dressings are observed.
- Once patient recovers from anesthesia the wrist & finger were examined for iatrogenic radial nerve injury.
- Parenteral antibiotics continued.
- On the 2nd Post-operative day, check dressing was done, the condition of the wound are noted.
- Check X-ray is taken both in Antero-Posterior & Lateral views.
- From the 5th Post-operative day oral antibiotics administered till the suture removal.
- Sutures are removed on the 10th day.
- The patient is discharged with the U-slab & reviewed after 4 weeks.
- On follow-up U-slab is removed, active shoulder (Pendulum exercises), elbow, forearm & wrist exercises are taught.
- Regular O.P.D follow-ups were done on the 6th week, 12th week & 6th month.
- At each visit. clinical & radiological evaluation done for pain, range of movement, fracture union & complications.

The Results were assessed based on:

- Pain.
- Deformity.
- Range of Movements of both shoulder & elbow.

- Fracture Union clinically & radiologically.
- Functional outcome depending on the A.S.E.S. score.
- Complications like Non-union, Infection & Radial nerve injury.

RESULTS

Thirty patients with closed fracture shaft of humerus were treated by open reduction and internal fixationwith dynamic compression plate.
The following observations were made of the data collected from study.

Preop X-Ray

Immediate Post-Op X-Ray

Follow-up X-Rayat14wks

Shoulder abduction

Shoulderint. Rotation

Shoulderext. rotation

Table 1: Age Incidence

Age Group	No. of Patients	Percentage
20-30	10	33.33%
31-40	7	23.33%
41-50	6	20.00%
51-60	5	16.66%
> 60	2	6.66%

There was a higher incidence of shaft humerus fracture in 10 (33.33%) patients of 20-30 years age group in this study

Table 2: Sex Incidence

Sex Group	No. of Patients	Percentage
Male	20	66.66%
Female	10	33.33%

Males 20(66.66%) predominated over females in this study.

Table 3: Occupation

Occupation	No. of Patients	Percentage
House Wives	6	20%
Labourers and Farmers	16	53.33%
Driver, Students & Business men	8	26.66%

Table 4: Side Effected

Side Effected	No. of Patients	Percentage
Right	14	48.66%
Left	16	53.33%

Left shaft of humerus was involved in a majority of cases 16(53.33%)

Table 5: Mode And Site Of Injury

Mode and Site of Injury	No. of Patients	Percentage
RTA	23	76.66%
Accidental Fall	4	13.33%
Assault	3	10%

Table 6: Level Of Injury

Level of Injury	Klenerman's Type	No. of Patients	Percentage
Upper 1/3	Type-I	2	6.66%
Junction of Upper & Middle 1/3	Type-II	3	10.00%
Middle 1/3	Type-III	16	53.33%
Junction of middle & lower 1/3	Type-IV	9	30.00%

In the study, Klenerman's classification of fracture shaft humerus is followed, most of the cases are type III i.e; middle third fracture 16(53.33%).

Table 7: Type Of Fracture

Type of Fracture	No. of Patients	Percentage
Transverse	12	40.00%
Oblique	8	26.66%
Spiral	4	13.33%
Segmental	0	0.00%
Comminuted	6	20.00%

In the study, Klenerman's classification of fracture shaft humerus is followed, most of the cases are type III i.e; middle third fracture 16(53.33%).

Table 8: Post Operative Immobilization Time (Weeks)

Post Operative Immobilization time (Wks)	No. of Patients	Percentage
6-8 Weeks	23	76.66%
12 Weeks	7	23.33%
> 12 Weeks	0	0.00%

Duration of Post-Operative immobilization routinely immobilized for a period of 2 months i.e. 8 weeks.

Table 9: Time taken for fracture union

Weeks	No. of Patients	Percentage
10-12 Weeks	13	43.33%
13-15	12	40.00%
16-18	5	16.66%
Non union	0	0.00%

In the study most of the cases united within 10-15 weeks. Out of 30 cases, only 5 cases took more than 15 weeks for union. No non-unions were reported.

Table 10: Severity of Pain

Weeks	No. of Patients	Percentage
No Pain	20	66.66%
Mild Pain	8	26.66%
Moderate Pain	2	6.66%
Severe Pain	0	0.00%

Only 2 patients had moderate pain and 8 patients had mild pain after 6 months. Rest of them have no pain. No cases reported with severe pain.

Table 11: Functional Outcome

ASES Score	No. of Patients	Percentage
Grade I	28	93.33%
Grade II	1	3.33%
Grade III	1	3.33%
Grade IV	0	0.00%

The functional outcome is measured by ASES Score. 28 patients were of grade I, and 1 patient was of grade II and grade III each.

Table 12: Complications

Complications (Post-Op)	No. of Patients	Percentage
Non union	0	0.00%
Infection (Superficial)	2	6.66%
Radial nerve neuropraxia	0	0.00%

Only 2 cases of superficial infection were reported which subsided with antibiotics

Table 13: Results

Functional Results	No. of Patients	Percentage
Excellent	25	83.33%
Good	4	13.35%
poor	1	3.33%

A detailed analysis of the function of 30 patients in the present study was done based on Romen et al criteria of which, 25 had excellent results, 4 had good results and 1 had poor result.

Table 14: Age Distribution in Various Studies

Mc Cormack et al 8	2000	44	49
Present Study	2025	30	40.9

The average age of all cases in this series was 40.9 Yrs. The fracture is more common in the age group of 20-30years.The average age in a study of 39 humeral fractures conducted by Bell 9, Beauchamp et al10) showed that the average age of all cases was 31.5Yrs. In a study of 36 humeral fractures conducted by Griend et al, 10 the average was 36 years.

Our study showed that the average age was similar to the reported studies when a smaller group of people were analysed. The average age increases when the series consists of a larger group of patients

Table 15: Sex Incidence in Various Studies

Study Series	Year	M : F Ratio	% of Males
Mc Cormack et al 8	2000	28 : 16	63.6%
Present Study	2025	20 : 10	66.6%

There were 20 male and 10 female patients showing male preponderance in our study. In a study by Mc Cormack et al 8, there were 20 males and 16 females.

Table 16: Mode of Injury in various Studies

Series	Year	Total No. of Patients	Commonest Mode of Injury
MC Cormack RG et al 8	2000	44	RTA
Present Study	2025	30	RTA

Majority of the cases sustained fractures from road traffic accidents. Most of the series reported that a high energy trauma was required to produce the fracture in younger patients and low energy trauma was the cause in elderly, who had osteoporotic bone.

Table 17: Site of fracture of various Studies

Series	Year	Total No. of Patients	Commonest Site
Present Study	2025	30	M/3rd

In our series 16 (53.33%) cases out of 30, the fractures were located in M/3rd of the shaft which was similar to most of the studies reported.

Table 18: Rate of fracture Union obtained in various Studies

Series	Year	Total No. of Patients	Delayed Union	Non- Union	Overall Result
Present Study	2025	30	-	-	30

In our study of 30 cases, none of them showed delayed union (or) non- union, all the 30 fractures were united.

Table 19: Range of Mobility of Elbow and Shoulder

Series	Year	Total No. of Patients	Good range of Mobility	Percentage
Present Study	2025	30	29	96.66%

In our study of 30 patients; 29 patients had good range of movements at the shoulder and elbow. Our results in mobility at shoulder and elbow joints are comparable with those of Bell MJ et al and MC Cormack RG et al.

DISCUSSION

The average ASES score obtained was 48.93 in our series. This is comparable to the ASES score of 48 obtained by MC Cormack RG et al 8 when treating humeral shaft fractures with DCP and a score of 47 when treating with interlocking intra medullary nail fixation. In our study of 30 patients, 25 (83.33%) patients had excellent results; 4 patients (13.33%) had good result and 1 patient (3.33%) had poor result.The results obtained by various modalities of treatment have varied from 75% with good or excellent results to 100% good (or) excellent results. Our study has 96.66% excellent to good results.

Strict adherence to the AO principles during fixation, meticulous attention to maintenance of Asepsis during surgery, patient education and well planned rehabilitation programmeare required to obtain better results. The average time to union was 12 weeks with a range of 10 weeks to 20 weeks. Comminuted fractures compared to simple fractures took more time for union.

In most of our cases the fracture was opened by an anterolateral approach. The anterolateral approach reduces the risk of an intraoperative radial nerve injury. For this approach, the patient is in a supine position and the plate is positioned easily on the anterolateral smooth surface of the bone without prior bending.

No patient had vascular impairment distal to the fracture. In our series of patients open reduction and internal fixation with DCP yielded better results when patient was taken for surgery within 3 days. The advantages we had during Dynamic Compression plating were:

- It is comparatively easier.
- Satisfactory and accurate reduction under direct vision.
- Non-union is rare.
- Soft tissue inter position was eliminated.
- Release of the radial nerve whenever required and its thorough inspection.
- Complications were minimal.
- To eliminate prolonged immobilization and facilitate rapid mobilization.

Pauwel states that it is perhaps the easiest of the major long bones to treat by open reduction and internal fixation with DCP and thus convert the tensile forces to compression forces on the convex side of an eccentrically loaded bone. It gives good contact between the two fracture fragments for healing and

uniting compared with antegrade intramedullary nailing which has the disadvantages of shoulder impingement and adhesive capsulitis. Thus for all these reasons the best results could be gained by dynamic compression plating using AO techniques.

CONCLUSION

This study was conducted to assess the outcome of Dynamic Compression Plating in fractures of the shaft of the humerus. Non operative treatment for fracture of the humeral shaft in patients with multiple injuries is difficult and the incidence of delayed union and nonunion has been reported to be higher in these patients. Internal fixation with DCP in these circumstances may relieve pain, protect adjacent soft tissue from further injury, and prevent the so called "fracture disease" and facilitate nursing and rehabilitation. Fracture shaft of the humerus is a major injury, which commonly results from road traffic accidents which are increasing in proportion. A fall may cause a fracture of the humerus in elderly patients who have more osteoporotic bone. People affected are mainly in the active earning group and most of the fractures are closed and associated with other injuries. The middle third is the most common site of the fracture and fracture occurring at the junction of the middle third and lowered third are more prone for radial nerve palsy. Most of the radial nerve injuries are neuropraxias and vascular impairment is rare. Dynamic compression plating method by AO technique is better than conservative treatment or antegrade intramedullary nailing. It gives good range of movements at shoulder and elbow by allowing early mobilization

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REFERENCES

1. Rockwood Green's – Fractures in Adults. Fourth edition, 1996; 1025- 1053.
2. Whitson. R.O – Relation of radial nerve to the shaft of the Humerus.J.B.J.S. Vol-36A, 1954, 85-91.
3. Arthur Hoistein& G.B. Lewis – Fractures of the humerus with Radial nerve paralysis. J.B.J.S. Vol-45A, 1963, 1382-1388.
4. klenerman, L. – Fracture of shaft of the Humerus. J.B.J.S. Vol-48B, 1966, 105-111.
5. Naiman P.T, Schein A.J, & Siffert. R.S. Use of ASIF compression plates in selected shaft fractures of upper extremity – A preliminary report, clinical orthop Vol-71, 1970, 208-211.
6. S.M. Perren Physical & Biological Aspects of Fracture Healing with Special reference to Internal Fixation. C.O.R.R. No. 358, Jan 1979, 175-196.
7. P.V.A. Mohandas, S. Ravindran, Management of fresh fractures of the shaft of the humerus by Internal Fixation, Indian Journal of Orthopaedics, Vol-16, 1982, 44-51.
8. R.G. McCormack, D.Brien, R.E.Buckley, M.D.McKee, J.Powell, E.H.Schemitsch-Fixation of fractures of the shaft of the Humerus by Dynamic compression plate or Intramedullary nail J.B.J.S. Vol-82B, 2000, 336-339.
9. M.J. Bell, C.G. Beauchamp, J.K. Kellam, R.Y. Mc Murtry – The Resultof Plating Humeral shaft fractures in patients with multiple injuries.J.B.J.S. Vol-67B, March 1985, 293-296.
10. Robert Vander Griend, M.D., John Tomasin, M.D., E. Frazier Ward,M.D & Jackson-Open Reduction & Internal Fixation of Humeral Shaft Fractures J.B.J.S. Vol-68A, March 1986, 430-433.