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Functional Outcomes Of Locking Compression Plate (Lcp) In Surgical Management Of Humerus Shaft Fractures

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Abstract

Background And Objective: The aim of this prospective study was to access the outcomes and complications of diaphyseal fracture of humerus treated with locking compression plates (LCPs).

Materials And Methods: Thirty patients with fractures of the shaft of the humerus, treated with plate osteosynthesis. Clinical and radiological assessments were made at 6wk, 12th week & 24thweek . Primary outcome measures like blood loss, operative time, mobilisation, time to fracture union, union rate and secondary outcome measures (functional outcome and complications) were accessed. The constant and Murley scoring system and VAS scoring were used to access the shoulder and elbow functions and pain.

Results: All fractures united following osteosynthesis. Average time to union was 19 weeks (range: 18-24 weeks). Complications included delayed union & transient radial nerve palsy . All patients in the study had Constant and Murley Score between 71-85 indicating good outcome at final follow-up. 83.33% cases (n=25) in study had mild pain, while 16.66% cases (n=5) had moderate grade of pain by VAS score at follow-up

Conclusion: Plate Osteosynthesis with locking compression plates (LCP) provides stable fixation, direct visualization, radial nerve protection & promotes rapid union. LCP is costly but gives more stable strut & angle stable fixation so it is more useful because of large amount of stress on humerus bone due to versatility of shoulder joint and technically a mature option in complex fracture, revision operations and specially in osteoporotic bones.

Keywords: humerus fractures, locking compression plates, constant murley score,visual analogue score

Introduction

Fractures of the humeral shaft account for roughly 3% of all fractures; most can be treated non-operatively. Charnley stated, “It is perhaps the easiest of the major long bones to treat by conservative methods.”. Historically, methods of conservative treatment have included skeletal traction, abduction casting and splinting, Velpeau dressing, and hanging arm cast, each with its own advantages and disadvantages. Functional bracing has essentially replaced all other conservative methods and has become the “gold standard” for non-operative treatment because of its ease of application, adjustability, allowance of shoulder and elbow motion, relatively low cost, and reproducible results.

The choice of operative treatment for a humeral shaft fracture depends on multiple factors.: (1) fracture indications, (2) associated injuries, and (3) patient indications. Some indications are more absolute than others. Failure of conservative treatment, pathological fracture, displaced intra-articular extension, vascular injury, and brachial plexus injury almost always require surgery. Other conditions, such as minimally displaced segmental fractures and

obesity, are only relative indications. Our most common indication for operative treatment is early mobilization of patients with polytrauma. Treatment decisions must take all factors into consideration, tailoring the treatment to the specific patient.

The goal of operative treatment of humeral shaft fractures is to reestablish length, alignment, and rotation with stable fixation that allows early motion and ideally early weight bearing on the fractured extremity. Options for fixation include plate osteosynthesis, intramedullary nailing, and external fixation.

Plate osteosynthesis remains the "gold standard" of fixation for humeral shaft fractures.

The successful treatment of a humeral shaft fracture may not end with bony union. In the current emphasis on a holistic approach to patient care the treating Orthopaedic surgeon may be in an ideal position to intervene and improve a patient's life beyond what is traditionally recognized as the surgeon's role. As with most orthopaedic injuries, the successful treatment of a humeral shaft fracture demands a knowledge of anatomy, surgical indications, techniques and implants, patient functions and expectations.

The locked compression plate (LCP), which has features of compression and point bone-plate contact (minimum contact) is used for fixation of humeral shaft fractures. Many authors have proved the superiority of locking plates over dynamic compression plates in various cadaveric long-bone models. Some biomechanical studies have suggested that locking-plate constructs are stiff and suppress interfragmentary motion to a level that may be insufficient to reliably promote secondary fracture-healing. Plate Osteosynthesis with LCP provides stable fixation, direct visualization, radial nerve protection & promotes rapid union. LCP is costly but gives more stable strut & angle stable fixation so it is more useful because of large amount of stress on humerus bone due to versatility of shoulder joint and technically a mature option in complex fracture, revision operations and osteoporotic bones. The number of studies on the use of LCP in humerus fractures are very less.

With this background, this study was done to access the functional outcome of locking compression plates in the surgical management of humerus shaft fractures.

Materials And Methods:

During the period of 2 and half years from July 2019 to December 2021,20 patients with fracture shaft of humerus were admitted to our hospital for internal fixation.

Inclusion Criteria

1. Skeletally mature Patients of age group >18years
2. Males and females.
3. Fresh Simple Fractures.
4. Fresh Type 1 Gustilo -Anderson Compound Fractures.
5. With or without radial nerve palsy.
6. Displaced fractures

Exclusion Criteria:

1. Patients less than 18 years
2. Pathological Fractures
3. Malunited Fractures.
4. Compound type 2,3A,3B and 3C Fractures.
5. Infected Fractures.
6. Fracture more than 3 weeks old.
7. Associated injuries of ipsilateral shoulder, forearm and elbow.
8. Patients not willing for study.

In all cases selected, after valid consent all patients were operated on between the 1st and 7th day after admission. All of the operations were performed under general anaesthesia, with the patient placed in the lateral decubitus position, using the posterior approach. The radial nerve was exposed and protected, then the fracture site was dissected to remove hematoma and soft tissue interposing between the fragments. The fracture fragments were reduced and plate osteosynthesis was done with LCP using at least three screws in each end of the plate. Wound closure was done in layers and postoperative antibiotics and analgesics were started. Suture removal was typically done on 12-14th day and elbow movement was started as early as possible depending on the compliance of the patient.

Patients were followed up on 6th,18th, 24th weeks for radiological and functional outcomes. Check x-ray was taken at every visit and patient was clinically and radiologically assessed for fracture union, functional

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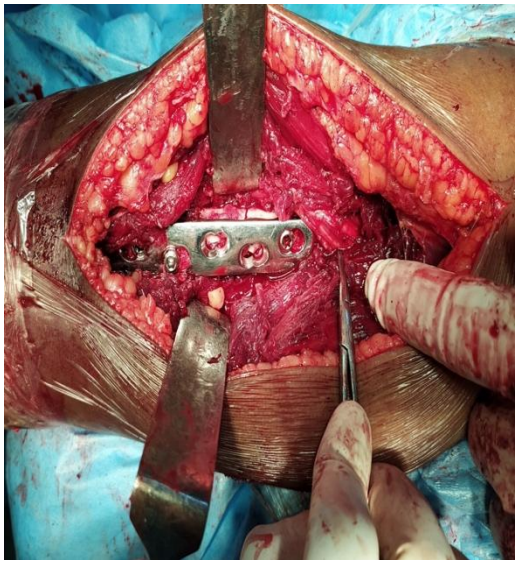
outcome and complications. Complications emerged (if any) in preoperative, intraoperative, postoperative, or during follow up period was treated appropriately

Constant and Murley scoring used for functional outcomes and VAS scoring for pain.

Figure 1: Patient positioning

Figure 2: Plate application with radial Nerve protected



Results:

A total of 30 cases of shaft of humerus fracture were enrolled in the study who were managed by Locking Compression Plate (LCP). Majority of enrolled cases were females (63.33%) with a female: male ratio 1:0.58. 23.33% of the enrolled cases had no comorbidities, 46.66% had diabetes mellitus, while 40% had hypertension. (Table 1)

Table 1: Demographic and baseline details of enrolled patients

Feature of case	*Number of enrolled cases*
Age group distribution	

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18-30 years	3 (10%)
31-43 years	7 (23.33%)
44-55 years	13 (43.33%)
>55 years	7 (23.33%)
Gender distribution	
Male	11 (36.66%)
Female	19 (63.33%)
Comorbidities	
Nil	7 (23.33%)
DM	14 (46.66%)
HTN	12 (40%)
Asthma	1 (3.33%)
Others	1 (3.33%)

19 patients in study suffered from right sided humerus fracture (63.33%). Fall from height was the commonest nature of trauma (60%), while 33.33% suffered from RTA. 14 patients (46.66%) in study suffered from direct injury while remaining 53.33% from indirect injury. Associated injuries was noted in 40% cases, radial nerve injuries and other limb injuries being common injuries in 16.66% cases each. Commonest fracture pattern noted was transverse type (36.66%), followed by comminuted fractures (30%) and spiral type (20%). (Table 2)

Table 2: Fracture details of enrolled patients

Feature of case	*Number of enrolled cases*
Side of fracture	
Left	11 (36.66%)
Right	19 (63.33%)
Nature of trauma	
RTA	10 (33.33%)
Fall from height	18 (60%)
Trivial injury	2 (6.66%)
Mechanism of injury	
Direct	14 (46.66%)
Indirect	16 (53.33%)
Duration since injury	
< 1 week	27 (90%)
>1 week	3 (10%)
Associated injuries	
Nil	18 (60%)

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Radial nerve injury	5 (16.66%)
Head injury	2 (6.66%)
Other limb injuries	5 (16.66%)
Fracture pattern	
Transverse	11 (36.66%)
Oblique	3 (10%)
Comminuted	9 (30%)
Spiral	6 (20%)
Compound	1 (3.33%)

Majority cases were operated within 0-2 days of admission (53.33%). Half of the cases had hospital stay of 1 week, while 46.66% cases had a hospital stay between 1-2 weeks. (Table 3)

Table 3: Management details of enrolled patients

Feature of case	*Number of enrolled cases*
Time of surgery following admission	
0-2 days	16 (53.33%)
3-5 days	9 (30%)
6-8 days	5 (16.66%)
Hospital stay	
1 week	15 (50%)
1-2 weeks	14 (46.66%)
>2 weeks	1 (3.33%)

80% of the enrolled cases had fracture union between 18-24 weeks. 70% of the cases had mild pain while 30% had no pain at 6-months follow up. None of the patients had any deformity. Range of movement was good in 63.33% cases while it was very good in 36.66% cases. (Table 4)

Table 4: Patient outcomes of enrolled patients

Feature of case	*Number of enrolled cases*
Fracture union in weeks	
16-18 weeks	1 (3.33%)
18-24 weeks	24 (80%)
>24 weeks	5 (16.66%)
Pain at 6 months follow-up	
No pain	9 (30%)
Mild pain	21 (70%)
Deformity	

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Absent	30 (100%)
Present	0
Range of movement	
Very good	11 (36.66%)
Good	19 (63.33%)

All patients in the study had Constant and Murley Score between 71-85 indicating good outcome at final follow-up. 83.33% cases (n=25) in study had mild pain, while 16.66% cases (n=5) had moderate grade of pain by VAS score at follow-up. (Figure 1, 2)

Figure 1: Constant and Murley Scoring results in study

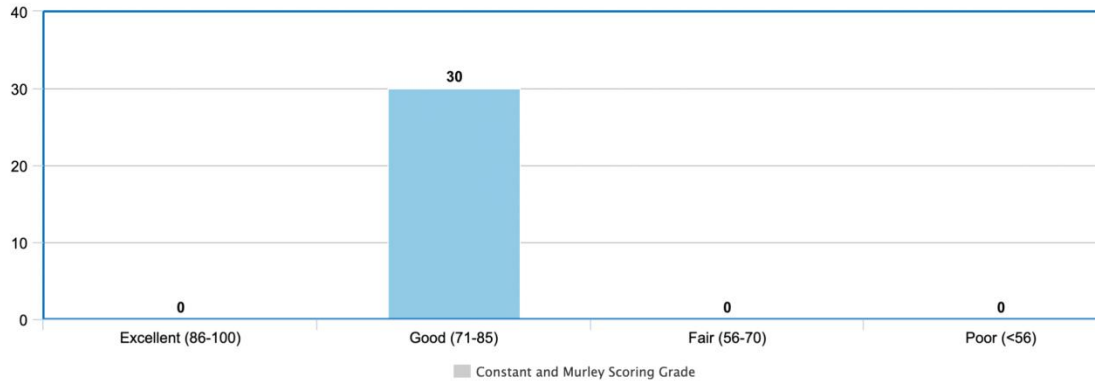
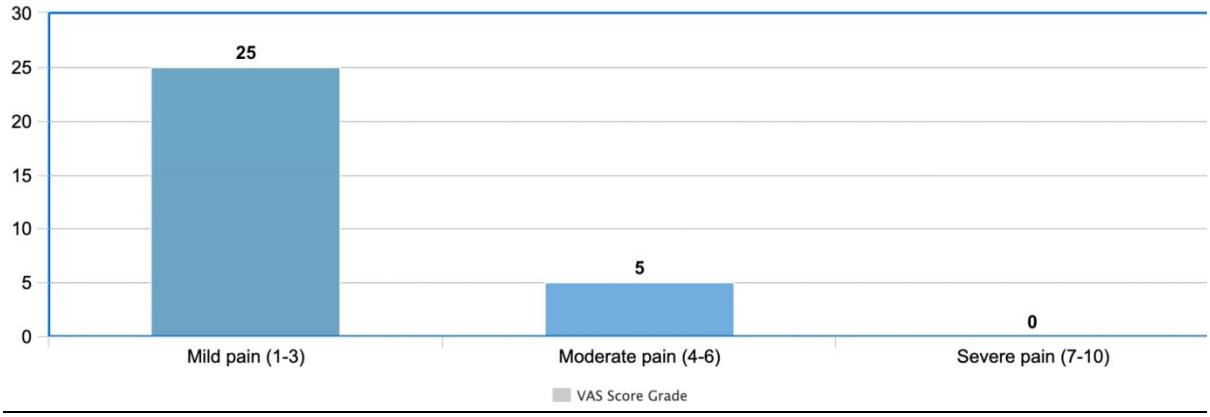


Figure 2: VAS score grade outcomes in study



24 of the 30 enrolled patients had no complications. Of the 6 cases, 5 cases were noted to have radial nerve palsy while one case had delayed union.

Table 5: Complications noted in study

Feature of case	*Number of enrolled cases*
No complication	24 (80%)
Radial nerve palsy	5 (16.66%)
Delayed union	1 (3.33%)

CASE 1:

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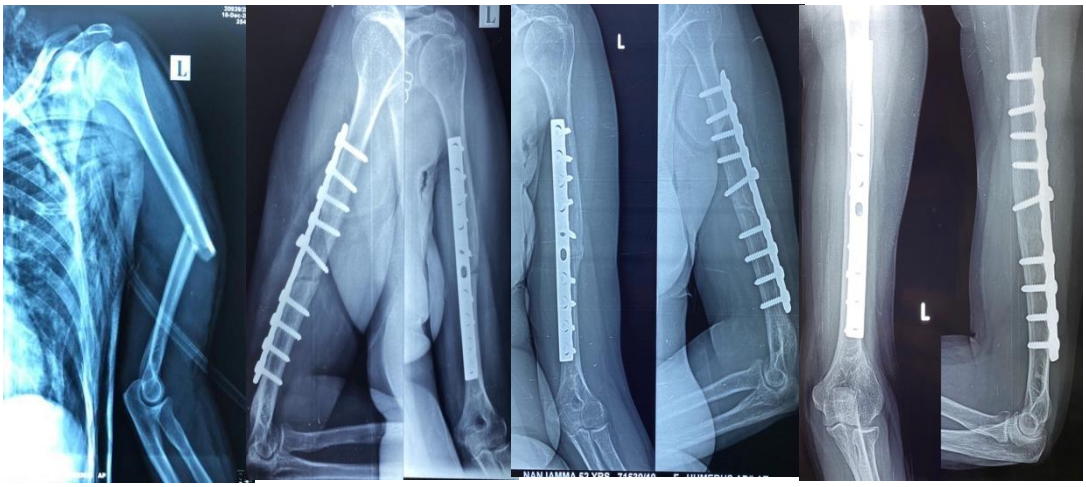
FIGURE: 5



FRACTURE 6TH WEEK. 18TH WEEK. 24TH WEEK

FIGURE: 6

RANGE OF MOVEMENT IN 24TH WEEK

CASE 2:

FIGURE: 7

FRACTURE 6TH WEEK. 18TH WEEK 24TH WEEK

FIGURE: 8

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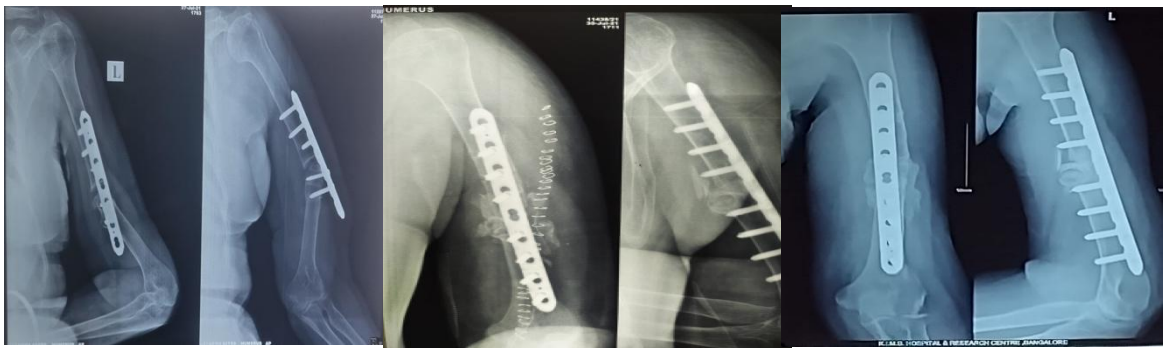
RANGE OF MOVEMENT AT 24TH WEEK

CASE 3: A case of nonunion with implant failure treated with LCP and bone graft



Nonunion with implant failure. **6th week** **24th week**

Conclusion:

The fracture of mid shaft of humerus accounts for 3.0% of all fractures and it commonly occurs due to a direct blow to the upper arm[5]. The displacement of the fragments depends on the relation of the site of fracture to the insertion of the deltoid muscle. There can be damage to the radial nerve where it lies in the spiral groove on the posterior surface of the humerus under cover of the triceps muscle[1]. Fractures in humerus are a result of trauma, such as a fall, motor vehicle accident, or motorcycle accident most frequently. Among elders, a fall on the outstretched arm can lead to it when the brunt of the injury is taken by humerus instead of the wrist[6].Sporting activities, working accidents, fall from a height, violence, and bone pathology account for less than 10% of humeral shaft fractures and pathologic and open fractures of the humeral shaft are uncommon and account for 6% to 8% and 2% to 5% of all diaphyseal humeral fractures, respectively[7].

With the rise in aging population, the incidence of these fractures has also been increasing[8]. These injuries are found to have bimodal age distribution affecting both young and old patients. Fragility-type fractures occur mostly among elderly (>65 years old) and fractures secondary to high-energy trauma, occur in younger patients (<30

Plate osteosynthesis remains the standard treatment resulting in high union rates but requires extensive dissection and soft tissue stripping having advantages of stable fixation, direct visualization & protection of the radial nerve.Plates exert static and dynamic forces based on the type of compression but with the disadvantages of necrosis, bone resorption and infection, because of large contour between the surface of plate and bones.. Recently, A biofriendly, locking compression plate (LCP) is hypothesized to be more suitable, especially for osteoporotic bones.LCP is further advanced as it follows the bio-mechanical principle of internal fixator and do not require friction between the plate and bone. Stability is maintained at the angular-stable screw-plate

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interface. It causes minimal surgical damage to the blood supply, maintenance of optimal bone structure , improved healing in the critical zone, minimal damage to bone lining after plate removal with reduced risk of re-fracture. LCP offer the advantage of increased pull-out resistance of the locking head screws compared with that of conventional screws too. LCP is more costly than other available plates. But LCP gives more stable strut & angle stable fixation so it is more useful in humerus fracture fixation because large amount of stress on humerus The LCP was a technically mature option in complex fracture situations, non-union and in revision operations after the failure of other implants. LCP was also found to be more superior in osteoporotic bones.

Overall the technique of fracture fixation with good compression at the fracture site is important than plate selection.

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