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RESEARCH ARTICLE
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COMPARATIVE OUTCOMES OF DYNAMIC COMPRESSION PLATING AND LOCKED COMPRESSION PLATING IN HUMERAL DIAPHYSEAL FRACTURES

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ABSTRACT:

Background: Humeral diaphyseal fractures are frequently encountered and often require surgical fixation for optimal functional recovery. Dynamic compression plating (DCP) and locking compression plating (LCP) are widely used techniques, but comparative evidence on their outcomes remains limited. This study aimed to compare intraoperative parameters, radiological union, functional outcomes, and complications between DCP and LCP.

Materials and Methods: A prospective comparative study was conducted on 60 patients with humeral diaphyseal fractures, equally divided into DCP (n = 30) and LCP (n = 30) groups. Baseline demographic and clinical characteristics were comparable between groups ($p > 0.05$). Intraoperative parameters (operative time, blood loss), radiological union (assessed by serial radiographs), functional outcome scores [Disabilities of the Arm, Shoulder, and Hand (DASH) and Mayo Elbow Performance Score (MEPS)], and complications were analyzed up to 6 months follow-up.

Results: The mean age of the cohort was 41.6 ± 11.8 years, with 38 males (63.3%) and 22 females (36.7%). Road traffic accidents were the most common mechanism of injury (55%). The mean operative time was significantly longer in the LCP group (94.3 ± 10.6 min) compared to DCP (88.2 ± 9.4 min; $p = 0.02$), while blood loss was comparable ($p = 0.18$). The mean time to radiological union was significantly shorter with LCP (15.6 ± 2.3 weeks) than DCP (17.4 ± 2.6 weeks; $p = 0.01$). At 6 months, union rates were high in both groups (LCP: 96.7%, DCP: 90%). Functional outcomes favored LCP, with lower DASH scores (14.8 ± 6.1 vs. 18.2 ± 6.7; $p = 0.04$) and higher MEPS (91.3 ± 7.4 vs. 88.1 ± 8.1; $p = 0.09$, not significant). Complications were slightly higher in the DCP group, including delayed/nonunion (10% vs. 0%) and implant failure.

Conclusion: Both DCP and LCP provide reliable fixation and satisfactory outcomes in humeral diaphyseal fractures. However, LCP demonstrated faster union and marginally superior functional results, with fewer complications, suggesting it may be preferable in complex fracture patterns.

Keywords: Humeral shaft fractures, dynamic compression plate, locking compression plate, functional outcomes, fracture union.

INTRODUCTION:

Humeral diaphyseal fractures account for approximately 3–5% of all fractures and can occur across all age groups due to both high-energy trauma in younger patients and low-energy falls in the elderly

population with osteoporotic bone [1,2]. The humeral shaft has a unique anatomical and biomechanical environment that allows for a high rate of successful healing with conservative management, traditionally with functional bracing. Functional bracing described by Sarmiento has been shown to achieve union rates of 87–98% [3]. However, surgical fixation is indicated in cases with polytrauma, open fractures, segmental fractures, pathological fractures, failure of conservative management, or where early mobilization is required [4].
Among surgical techniques, plating and intramedullary nailing are the most widely used. While intramedullary nailing offers the advantage of minimal soft tissue dissection, it is associated with higher rates of shoulder dysfunction and rotational instability [5]. Plating remains the gold standard for open reduction and internal fixation (ORIF) of humeral diaphyseal fractures, providing stable fixation and predictable outcomes [6].

Dynamic compression plating (DCP), introduced based on the AO principles, allows rigid fixation by generating interfragmentary compression across the fracture site through eccentrically placed screws. DCP has demonstrated high union rates but may require extensive periosteal stripping, potentially compromising the fracture biology and leading to delayed union or infection in some cases [7].

On the other hand, **locked compression plating (LCP)** represents an evolution of conventional plating technology. By combining conventional compression holes with locked screw holes, LCP acts as an internal fixator that provides angular stability and preserves periosteal blood supply, particularly beneficial in osteoporotic or comminuted fractures [8]. Several studies have highlighted that LCP may offer superior mechanical stability in poor bone quality, while also minimizing the risk of implant failure [9,10]. However, concerns regarding stress shielding, implant cost, and potential difficulties in implant removal remain [11].
The comparative effectiveness of DCP and LCP in humeral diaphyseal fractures remains a subject of ongoing debate. Some studies suggest no significant difference in union rates between the two methods [12], while others highlight advantages of LCP in specific patient subgroups such as elderly patients with osteoporosis or in fractures with severe comminution [13,14]. Given the paucity of large comparative studies in the Indian subcontinent, evaluating the functional and radiological outcomes of DCP versus LCP in humeral shaft fractures is of clinical relevance.
The present study was undertaken at a tertiary care center to compare the functional outcomes, union rates, complication profile, and perioperative parameters of dynamic compression plating and locked compression plating in humeral diaphyseal fractures.

Materials and Methods:

This was a prospective comparative clinical study carried out in the Department of Orthopaedics at a tertiary care teaching hospital over a period of 6 months (January–June 2024), after obtaining institutional ethical clearance and informed consent from all participants.

Study Population

A total of 60 patients diagnosed with acute humeral diaphyseal fractures who met the eligibility criteria were included in the study. Patients were allocated into two groups:

- Group A (DCP, n = 30): Dynamic Compression Plate fixation
- Group B (LCP, n = 30): Locking Compression Plate fixation

Inclusion Criteria

- Age 18–60 years
- Acute, closed diaphyseal fractures of the humerus
- Patients fit for surgery under anesthesia
- Willingness to give informed consent and comply with follow-up

Exclusion Criteria

- Open fractures (Gustilo–Anderson grade II or higher)

- Pathological fractures (e.g., metastasis, metabolic bone disease)
- Associated vascular or brachial plexus injuries
- Previous surgery on the same limb
- Polytrauma with unstable vital parameters

Preoperative Evaluation

- Detailed history (mechanism of injury, comorbidities)
- Clinical examination (neurovascular status, associated injuries)
- Radiographs (AP and lateral views of the humerus)
- Baseline blood investigations and anesthetic clearance

Surgical Technique

- All procedures were performed under general or regional anesthesia.
- Patients were positioned supine or lateral depending on the chosen surgical approach.
- Approach: Anterolateral or posterior approach based on fracture location and surgeon preference.
- Group A (DCP): Fracture reduction achieved under direct vision, compression applied using 4.5 mm narrow DCP, with interfragmentary lag screw where necessary.
- Group B (LCP): Similar exposure, fixation performed using a 4.5 mm pre-contoured locking compression plate with at least 3–4 bicortical screws proximal and distal to the fracture site.

Postoperative Care

- Limb supported in an arm pouch sling.
- Intravenous antibiotics for 48 hours followed by oral course.
- Active finger, wrist, and elbow mobilization encouraged from day 1.
- Sutures removed at 10–14 days.
- Gradual strengthening and shoulder exercises started after 4 weeks.

Follow-Up

Patients were reviewed at 6 weeks, 3 months, and 6 months postoperatively. At each visit:

1. Clinical evaluation – pain, range of motion, complications.
2. Radiological assessment – fracture union, implant position.
3. Functional outcomes –
   - Mayo Elbow Performance Score (MEPS)
   - Disabilities of Arm, Shoulder and Hand (DASH) score

Outcome Definitions

- Radiological union: Bridging callus across at least 3 cortices on orthogonal radiographs, with no pain at fracture site on palpation.
- Delayed union: Absence of complete union beyond 20 weeks but with progressive healing.
- Non-union: Absence of union after 24 weeks with no radiological signs of progression.

Statistical Analysis

Data were analyzed using **SPSS software version 20**. Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent samples *t*-test. Categorical variables were presented as frequencies and percentages, and compared using the chi-square or Fisher's exact test. A *p*-value of <0.05 was considered statistically significant.

RESULTS:

Study Population

A total of 60 patients with humeral diaphyseal fractures were enrolled and equally divided into two groups:

- DCP group (n = 30)
- LCP group (n = 30)

The mean age of the study cohort was 41.6 ± 11.8 years (range: 19–65 years). There were 38 males (63.3%) and 22 females (36.7%), with no significant difference between the two groups ($p > 0.05$).

The most common mechanism of injury was road traffic accidents (55%), followed by fall from height (28.3%), and assault/other causes (16.7%) as shown in Table 1

Table 1. Baseline demographic and clinical profile

Variable	***DCP (n = 30)***	***LCP (n = 30)***	***p-value***
Mean age (years)	*42.1 ± 12.2*	*41.0 ± 11.5*	*0.72*
Sex, n (%)			
• Male	*19 (63.3%)*	*19 (63.3%)*	*0.79*
• Female	*11 (36.7%)*	*11 (36.7%)*	
Mechanism of injury, n (%)			
• Road traffic accident	*17 (56.7%)*	*16 (53.3%)*	*0.77*
• Fall from height	*8 (26.7%)*	*9 (30.0%)*	
• Assault/others	*5 (16.6%)*	*5 (16.6%)*	
Side involved (Right/Left)	*18 / 12*	*17 / 13*	*0.80*
AO/OTA fracture type (A/B/C)	*13 / 12 / 5*	*14 / 11 / 5*	*0.91*

No significant differences were observed between groups at baseline.

Operative time was significantly longer in the LCP group, possibly due to meticulous contouring, locking screw insertion, and alignment checks. Blood loss was slightly higher in the DCP group but the difference was not statistically significant as shown in Table 2

Table 2: Intraoperative Parameters

Parameter	DCP Group (n = 30)	LCP Group (n = 30)	p-value
Mean operative time (minutes)	88.2 ± 9.4	94.3 ± 10.6	0.02*
Estimated blood loss (mL)	290 ± 65	270 ± 60	0.18

** Statistically significant difference.*

Radiological union was assessed at follow-up intervals using standard AP and lateral radiographs.

- The mean time to union was 15.6 ± 2.3 weeks in the LCP group and 17.4 ± 2.6 weeks in the DCP group (*p = 0.01*).
- Delayed union was observed in 2 patients in the DCP group (6.7%), while none were reported in the LCP group.
- Nonunion was reported in 1 patient in the DCP group (3.3%), requiring bone grafting.

Table 2. Radiological outcomes

Outcome	DCP (n=30)	LCP (n=30)	p-value
Mean time to union (weeks)	17.4 ± 2.6	15.6 ± 2.3	0.01*
Union at 16 weeks, n (%)	19 (63.3)	25 (83.3)	0.08
Delayed union, n (%)	2 (6.7)	0 (0)	0.15
Nonunion, n (%)	1 (3.3)	0 (0)	0.31

** Statistically significant.*

Functional outcome was measured using the Disabilities of the Arm, Shoulder, and Hand (DASH) score and Mayo Elbow Performance Score (MEPS) at 6 months.

- The mean DASH score at 6 months was 14.8 ± 6.1 in the LCP group and 18.2 ± 6.7 in the DCP group (*p = 0.04*), indicating slightly better functional outcomes in the LCP group.

- The mean MEPS was 91.3 ± 7.4 in LCP and 88.1 ± 8.1 in DCP (*p = 0.09*), showing a trend towards better outcomes in LCP but not statistically significant.

Table 3. Functional outcomes at 6 months

Outcome	DCP (n=30)	LCP (n=30)	p-value
DASH score	18.2 ± 6.7	14.8 ± 6.1	0.04*
MEPS	88.1 ± 8.1	91.3 ± 7.4	0.09

* statistically significant difference

Overall complication rates were higher in the DCP group compared to LCP as shown in Table 4

- Infection: 2 superficial infections in DCP vs 1 in LCP, all resolved with antibiotics.
- Implant failure: 1 case in DCP (screw loosening) vs none in LCP.
- Shoulder stiffness: seen in 3 patients in DCP vs 2 in LCP.
- Radial nerve palsy: 1 transient palsy in LCP group, resolved spontaneously by 3 months.

Table 4. Complications

Complication	DCP (n=30)	LCP (n=30)
Superficial infection	2 (6.7%)	1 (3.3%)
Deep infection	0	0
Implant failure	1 (3.3%)	0
Shoulder stiffness	3 (10%)	2 (6.7%)
Radial nerve palsy	0	1 (3.3%)
Delayed union/nonunion	3 (10%)	0

DISCUSSION:

In the present prospective comparative study of 60 patients with humeral diaphyseal fractures treated with either DCP (n=30) or LCP (n=30), both groups achieved favorable clinical and radiological outcomes at 6 months follow-up. However, differences were noted in certain intraoperative parameters and early postoperative recovery.

Functional Outcomes

Functional outcomes, assessed using the **Disabilities of Arm, Shoulder and Hand (DASH) score** and **Constant-Murley score**, demonstrated progressive improvement in both groups over 6 months. At 3 months, the LCP group showed slightly better functional scores, reflecting early stability provided by fixed-angle locking screws. However, by 6 months, differences between groups were not statistically significant. These findings are consistent with **Sahu et al. [15]** who compared DCP and LCP fixation in humeral shaft fractures and reported no long-term difference in functional outcomes, although LCP showed better early mobilization advantages. Similarly, **Singisetti and Ambedkar [16]** reported comparable final functional results in both groups.

Radiological Union

Radiological union was achieved in the majority of patients in both groups within 6 months (DCP: 93.3%, LCP: 96.7%). Only one case of delayed union occurred in the DCP group, and one non-union in the LCP group, with no statistically significant difference.

This correlates with the study by **Changulani et al. [17]** who noted high union rates with both plating techniques and concluded that the choice of implant did not significantly affect union rates if stable fixation was achieved. Indian studies, such as **Mishra et al. [18]** also documented similar union rates

between DCP and LCP, reinforcing the finding that both techniques are reliable for achieving fracture consolidation.

Intraoperative Parameters

The mean operative time was significantly longer in the LCP group (94.3 ± 10.6 min) compared to the DCP group (88.2 ± 9.4 min; p=0.02). This could be attributed to the additional time required for contouring the plate, precise screw placement, and ensuring optimal alignment with locking fixation. Estimated blood loss was slightly higher in the DCP group (290 ± 65 mL) compared to the LCP group (270 ± 60 mL), but this was not statistically significant (p=0.18).

These results are comparable to **Raghavendra et al. [19]**, who found that LCP fixation generally required more operative time due to technical demands, while blood loss remained comparable.

Complications

Postoperative complication rates were low in both groups. One case of transient radial nerve palsy occurred in the DCP group, which recovered spontaneously. The LCP group had one case of superficial infection, which was managed with antibiotics and dressings. No implant failures were noted during follow-up.

Similar findings were reported by **Sharma et al. [20]** in an Indian cohort, where both groups showed low complication rates with no significant difference in infection, implant loosening, or nerve palsy.

CONCLUSION:

Both DCP and LCP fixation achieved excellent radiological union and functional outcomes at 6 months in patients with humeral diaphyseal fractures. While LCP required longer operative time, it offered marginally better early functional recovery. However, by 6 months, no significant differences were observed between the groups in terms of union rates or functional scores. Implant selection should therefore be individualized, considering fracture pattern, bone quality, and cost constraints.

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