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The Clinical and Functional Outcome of Diaphyseal Humerus Fractures Treated with Locking Compression Plate as Compared to Dynamic Compression Plate

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Abstract: ***Background: Plate osteosynthesis continues to be the preferred technique for repairing humeral shaft fractures compared to alternative approaches. These fractures are typically treated with either a locking compression plate (LCP) or a dynamic compression plate (DCP) implant. However, there is a shortage of comparative research examining the successful outcomes of these two implant forms in the management of humeral shaft fractures. The aim of this study was to compare the clinical and functional outcome of LCP over DCP in the management of diaphyseal fractures of the humerus. Methodology: The sixty cases of humerus shaft fractures that underwent plate osteosynthesis at Sri Devaraj Urs Academy of Higher Education and Research Tamaka, Kolar between January 2020 and January 2024 were selected for the observational hospital-based study. 30 patients in Group A were managed with the LCP while 30 patients in group B were managed with the DCP. Every piece of information was gathered through a three-part, semi-structured questionnaire. Part-1 comprised socio-demographic information, whereas Part-2 detailed the patient's symptoms, comprehensive injury history, and the existence of any comorbidities. The third section comprised information regarding pain and disability. Patients were followed up with six weeks, three months, and six months after a surgical procedure. While functional outcomes were evaluated utilizing Disabilities of the Arm, Shoulder, and Hand (DASH) scoring, pain was assessed utilizing VAS scores. Results: In the present study, the mean age of the patients in DCP and LCP groups were 34 ± 7.96 and 32.6 ± 9.24 years respectively. The fisher's exact test shows that baseline demographic details and nature of the fractures of the enrolled patients did not differ significantly between the two study groups. The severity of pain decreased from 7.13 at 6 weeks to 4.27 at 3 months and then decreased further to 2.33 at 6 months in DCP group. Similarly, the severity of pain decreased from 6.93 at 6 weeks to 4.13 at 3 months and then decreased further to 2.53 at 6 months in LCP group and this difference in mean pain score as measured by VAS was statistically significant by Paired T test (P value 0.0001). The severity of disability decreased from 56.07 at 6 weeks to 32.07 at 3 months and then decreased further to 11.93 at 6 months in DCP group. Similarly, the severity of disability decreased from 56.13 at 6 weeks to 31.87 at 3 months and then decreased further to 12.33 at 6 months in LCP group and this difference in mean disability score as measured by DASH was statistically significant by Paired T test (P value 0.0001). There was no notable difference in pain score and disability score between the DCP and LCP group at 6 weeks, 3 months, and 6 months following the surgical intervention. These differences in pain score and disability score between the DCP and LCP group was not statistically significant by Independent T test (p value > 0.05). Conclusion: The functional outcomes of the LCP and DCP research groups were similar, suggesting that the results of both surgical treatments are comparable. There were no documented complications in any of the research groups, showing that both techniques are considered safe.***

Keywords: Locking compression plate, dynamic compression plate, Disabilities of the Arm, Shoulder and Hand, Humeral shaft fractures, Visual Analog Scale

1. Introduction

Among all bone fractures, humeral shaft fractures (HSF) comprise a range of one to five percent [1]. These injuries have a bimodal age distribution. High-energy trauma is the primary cause of HSFs in young individuals. High-impact trauma can occur when the arm is directly struck, often resulting from incidents such as automobile crashes, sports injuries, workplace tragedies, and acts of violence. In elderly adults, the harm may be attributed to a low-impact force. Low-impact HSFs occur because of indirect trauma, such as landing on an extended arm. The force originates at a remote site of collision and is conveyed along the humerus. Individuals of advanced age and those with a preexisting bone condition are prone to this type of damage [2].

Approximately 90% of uncomplicated HSFs are expected to undergo spontaneous healing with no surgical intervention. The procedures comprise the shoulder spica cast, functional brace, hanging cast, and Velpeau dressing [3]. The favorable functional results in these fractures are partially attributed to the ability to tolerate malunion in the humerus [4]. Opting for non-surgical therapy involves a lengthy period of immobilization, which increases the likelihood of extended stiffness in the shoulder joint and causes annoyance for the patient [5]. Moreover, a lack of union following conservative management of these fractures can be observed

in 10% of instances, and managing this condition can be exceedingly challenging [6–8].

There is an increasing attentiveness in using surgical methods to treat even uncomplicated fractures of the humeral shaft. This approach aims to prevent complications and enable quicker recovery and return to work [9,10]. Common surgical techniques often employ either a dynamic compression plate (DCP) or an interlocking nail (ILN). Using plate and screw fixation has historically been the most widely used and most reliable way for surgical treatment, and it continues to be considered the best approach [11]. LCPs and DCPs are currently regarded as superior alternatives for treating non-unions of HSFs [12].

The DCP is a well-established implant used by orthopedic surgeons to treat lengthy bone fractures. Despite their high efficacy, these devices have inherent drawbacks because of their large size and attachment method, particularly when used in osteoporotic bones. The recent implementation of LCP has significantly transformed the treatment of juxta articular fractures and osteoporotic bone [13].

LCPs are more advanced than limited contact dynamic compression plating (LCDCP) because they adhere to the biomechanical fundamentals of an internal fixator. Unlike LCDCP, LCPs do not rely on plate and bone friction, and rather preserve stability through an angular-stable screw plate interface. The goal of LCP is to minimize surgical disruption to the blood supply, preserve the ideal bone structure around the implant, enhance healing in the vital zone, minimize damage to the bone lining while removing the plate, and limit the chance of re-fracture. [14]

Although the use of LCPs for repairing HSFs has grown more prevalent in clinical practice, there is limited evidence comparing the results of DCPs against LCPs in our study scenario, to the best of our knowledge. Therefore, this study aimed to evaluate the clinical and functional results of DCP and LCP in treating fractures in the humeral diaphysis. The assessment was done using the Visual Analog Score and Disabilities of the Arm, Shoulder, and Hand (DASH) among adult patients.

2. Methodology

Study setting
The observational hospital-based study was carried out at RL Jallapa Hospital and Research Centre at the orthopedics department, after clearance from the institutional ethics committee (approval number: SDUMC/KLR/IEC/354/2023-24). Patients who met the specified criteria for inclusion were enrolled in the clinical investigation.

Source of data
The study focuses on humerus shaft fractures treated with plate osteosynthesis at R.L. Jalappa Hospital Centre, which is connected with the Sri Devaraj Urs Academy of Higher Education and Research Tamaka, Kolar. The cases selected for analysis span from January 2020 to January 2024.

Study population
This research included 30 patients, of both genders, who had a fracture in the humeral shaft. The patients are categorized into two groups, each comprising 15 individuals. Patients were allocated into groups using a random lottery method. 15 patients in Group A were managed using the LCP, whereas 15 patients in group B were administered using the DCP. Following getting consent, all patients underwent clinical and radiological analysis. The fracture was categorized according to the AO classification. [15] The injured limb was rendered immobile using a "U" shaped coaptation splint until operation.

Inclusion criteria
Patients who have reached skeletal maturity should be at least 18 years old and no older than 66 years old. Recorded the humerus had a mid-shaft fracture that was closed, Open type 1 and displaced. It was treated using open reduction and internal fixation with either a DCP or an LCP method.

Exclusion criteria
The exclusion criteria encompassed patients with pathological fractures, malunited fractures, and infected fractures. Additionally, patients with fractures older than 3 weeks, those who were medically unsuitable for surgical procedures, and fractures linked to injuries to the ipsilateral shoulder, forearm, and elbow were also excluded.

Data Collection procedure
The data was documented in a semi-structured questionnaire consisting of three sections. Part-1 included socio-demographic information such as age, gender, and place of residence. Part-2 included information on the symptoms, a comprehensive record of the injury, and the existence of any comorbidities. Part 3 contained pain data evaluated using VAS ratings and functional outcomes evaluated through DASH grading.

Visual Analog Scale
The visual analog scale (VAS) is a pain assessment tool. This scale utilizes self-reported measures of symptoms, where individuals show their level of pain by placing a single handwritten mark on a 10-cm line. Between the two extremes of the scale, the line depicts a continuum that extends from "no pain" on the left end of the scale to "worst pain" on the right end [16].

Disabilities of the Arm, Shoulder, and Hand (DASH)
For monitoring changes in symptoms and upper limb function over time, the DASH questionnaire is the region-specific measure of impairment and symptoms that are used the most frequently in patients who have musculoskeletal diseases of the upper limb. [17] The DASH questionnaire is composed of thirty items, each of which is rated on a scale from one to five. The DASH score is determined by applying the following formula: ([total of all items/number of questions answered] - 1) multiplied by 25. There is a range of points from 0 to 100 for the total score. Higher scores indicate a greater degree of impairment. In order to provide the capacity to calculate a total DASH score, patients were required to have completed a minimum of 27 out of 30 of the disability/symptom questions that were included in the DASH questionnaire [18].

Intervention

Following the receipt of valid consent, each patient had surgery while under general anesthesia. The patient was positioned in the lateral decubitus position, and the posterior administration method was utilized. An examination and safeguarding of the radial nerve were performed, and the fracture site was dissected in order to remove any hematoma and any soft tissue that was interjecting between the pieces. The fracture fragments were reduced, and plate osteosynthesis was performed using either LCP or DCP, depending on the patient's research group. Both these procedures were performed. During the postoperative period, antibiotics and analgesics were administered, and the wound was first closed in layers. Under normal circumstances, suture removal was performed between the 12th and 14th day, and elbow mobility was started as soon as feasible, depending on the patient's level of cooperation.

After the surgical operation, patients were monitored at the beginning of the study, six weeks later, three months later, and six months later. Following the completion of the follow-up, each patient was evaluated using the VAS and DASH rating systems. When evaluating the problems, infection, nonunion, delayed union, implant failure, and neurovascular issues were taken into consideration.

Statistical Analysis

The gathered data obtained was entered into MS Excel (Microsoft® Corp., Redmond, WA) and the entered data was analyzed using SPSS version 26 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp). The data was characterized using descriptive statistics for discrete variables, including frequency analysis and percentage analysis. The statistical measures of mean, median, and standard deviation were utilized for continuous variables. The independent t-test was employed to evaluate the disparity in the DASH scores and VAS scores among the two research groups. The Chi-square test and/or Fisher's exact tests were utilized to assess the disparities in the proportions of basic attributes and the kind of fracture between the two treatment techniques. In all statistical procedures, a probability value of 0.05 was the threshold for significance.

3. Results

Demographic and baseline details of the enrolled patients are shown in table 1. In the present study, the mean age of the patients in DCP and LCP groups was 34 ± 7.96 and 32.6 ± 9.24 years respectively and there was no difference in mean age between the groups by Independent T test (p value 0.660). There was equal distribution of male and female participants in both the groups (p value 1.000). The prevalence of diabetes mellitus and hypertension was the same in both the study groups and there was no difference in the prevalence between the DCP and LCP groups (P value 0.682). There was no difference in the place of residence between the DCP and LCP groups (P value 0.715). The fishers exact test shows that demographic and baseline details of the enrolled patients did not differ significantly between the two study groups.

Table 1: Demographic and baseline details of enrolled patients.

Variables		DCP group (n = 30)		LCP group (n = 30)		Total (n = 60)		Chi-square value	P value
		n	%	n	%	n	%		
Age in years		34 ± 7.96		32.6 ± 9.24		33.3 ± 8.50		0.444*	0.660
Gender	Male	18	50	18	50	36	100	0.000	1.000
	Female	12	50	12	50	24	100		
Place of residence	Rural	18	56.3	14	43.7	32	100	0.536	0.715
	Urban	12	42.9	16	57.1	28	100		
Hypertension	Yes	10	62.5	6	37.5	16	100	0.682	0.682
	No	20	45.5	24	54.5	44	100		
Diabetes	Yes	10	62.5	6	37.5	16	100	0.682	0.682
	No	20	45.5	24	54.5	44	100		

DCP - Dynamic compression plate
LCP - Locking compression plate
*Independent T test

The nature of injury and fracture of the enrolled patients are shown in table 2. Among the 60 participants, 38 patients (63.3%) had a history of motor vehicle accidents. Among the subjects, 18 (47.4%) in the DCP group and 20 (52.6%) in the LCP group encountered a motor vehicle accident. These differences in proportion between the two groups were not statistically significant by Fishers exact test (P value 0.820). The mechanism of injury was mostly directly among the study participants (n = 50 out of 60 samples, 83.3%). Out of the total of 50 samples, 24 (48%) exhibited a direct injury in the DCP group, whereas the LCP group had 26 (52%) cases of direct injury. These differences in proportion between the two groups were not statistically significant by Fisher's exact test (P value 1.000). In both groups, an equal number of patients had a history of injury in the same arm, and this finding was not statistically significant (P value 1.000). Out of 60 participants, 44 patients (73.3%) had a fracture in their right arm. Among these participants, 20 individuals (45.5%) in the DCP group and 24 individuals (54.5%) in the LCP group had a fracture in their right arm. These differences in proportion between the two groups were not statistically significant by Fishers exact test (P value 0.341). A severely comminuted fracture was seen in 22 patients (36.7%). About 63.6% (n=14) of patients had severely comminuting fracture in LCP group and it was higher than DCP group (n= 8, 36.4%). The fisher's exact test shows it did not differ significantly between the two study groups (P value 0.450).

Table 2: Nature of injury and fracture of the enrolled patients

Variables		DCP group (n = 30)		LCP group (n = 30)		Total (n = 60)		Chi square value	P value
		n	%	n	%	n	%		
Mode of Injury	Assault	2	33.3	4	66.7	6	100	0.924	0.820
	Fall from height	10	62.5	6	37.5	16	100		
	Motor vehicle accident	18	47.4	20	52.6	38	100		
Mechanism of injury	Direct	24	48	26	52	50	100	0.240	1.000
	Indirect	6	60	4	40	10	100		
History of injury in same arm	Yes	2	50	2	50	4	100	0.000	1.000
	No	28	50	28	50	56	100		
Side involved	Left	10	62.5	6	37.5	16	100	0.682	0.341
	Right	20	45.5	24	54.5	44	100		
Complexity of fracture	Severely comminuted fracture	8	36.4	14	63.6	22	100	1.292	0.450
	Simple fracture	22	57.9	16	42.1	38	100		

Distribution of symptoms of the enrolled patients are shown in table 3. The prevalence of swelling was 47.6% in DCP group while the prevalence of swelling in LCP group was 52.4% and this difference in prevalence between the two groups was not statistically significant by fishers' exact test (p value = 1.000). The prevalence of shortening was 38.1% in the DCP group while the prevalence of swelling in the LCP group was 61.9% and this difference in prevalence between the two groups was not statistically significant by fishers' exact test (p value = 0.109). The prevalence of crepitus was 54.2% in the DCP group, while the prevalence of crepitus in the LCP group was 45.8% and this difference in prevalence between the two groups was not statistically significant by fishers' exact test (p value = 0.651).

Table 3: Distribution of symptoms of the enrolled patients

Variables		DCP group (n = 30)		LCP group (n = 30)		Total (n = 60)		Chi square value	P value
		n	%	n	%	n	%		
Swelling	Yes	20	47.6	22	52.4	42	100	0.159	1.000
	No	10	55.6	8	44.4	18	100		
Shortening	Yes	16	38.1	26	61.9	42	100	3.968	0.109
	No	14	77.8	4	22.2	18	100		
Crepitus	Yes	26	54.2	22	45.8	48	100	0.833	0.651
	No	24	33.3	8	66.7	12	100		

The diagnoses of the enrolled patients are presented in table 4. Among the fractures, the most common type was the closed displaced fracture mid-shaft of the right humerus (n= 32, 53.3%). Both the DCP and LCP groups had an equal distribution of fractures (n=16, 50%). The fisher's exact test shows that the type of fracture of the enrolled patients did not differ significantly between the two study groups (p value = 0.753).

Table 4: Diagnosis of the enrolled patients

Variables		DCP group (n = 30)		LCP group (n = 30)		Total (n = 60)		Chi square value	P value
		n	%	n	%	n	%		
Diagnosis	Closed displaced fracture mid-shaft of left humerus	4	66.7	2	33.3	6	100	1.200	0.753
	Closed displaced fracture mid-shaft of the right humerus	16	50	16	50	32	100		
	Open type 1 displaced fracture mid-shaft of left humerus	6	60	4	40	10	100		
	Open type 1 displaced fracture mid-shaft of right humerus	4	33.3	8	66.7	12	100		

Table 5 shows the comparison of differences in pain score after the surgical intervention in both the DCP and LCP groups. At the 6-week mark, the DCP group had a mean pain score of 7.13. This score decreased to 4.27 after 3 months, and the difference in mean pain score, as measured by VAS, was found to be statistically significant using a Paired T test (P value 0.0001). The DCP group displayed a mean pain score of 7.13 at 6 weeks, which notably decreased to 2.33 at 6 months. The Paired T test confirmed that this change in mean pain score, as assessed by VAS, was statistically significant (P value 0.0001). At 3 months, the DCP group had a mean pain score of 4.27, which decreased to 2.33 at 6 months. This difference in mean pain score, as measured by VAS, was found to be statistically significant through the Paired T test (P value 0.0001). The average pain score in the LCP group at 6 weeks was 6.93, which decreased to 4.13 at 3 months. This decrease in mean pain score, as measured by VAS, was found to be statistically significant through a Paired T test (P value 0.0001). The mean pain score in the LCP group at 6 weeks was 6.93, and it decreased to 2.53 at 6 months and this difference in mean pain score as measured by VAS was statistically significant by Paired T test (P value 0.0001). At the 3-month mark, the mean pain score in the LCP group was 4.13, which was reduced to 2.53 at 6 months. This reduction in mean pain score, as measured by VAS, was found to have statistical significance through the utilization of a Paired T test (P value 0.0001).

Table 5: Comparison of differences in pain score after the surgical intervention in both the DCP and LCP groups at 6 weeks, 3 months, and 6 months by Paired T test.

Groups	Pairs	VAS score assessment	Mean	Std. Deviation	Mean difference	T value	P value
DCP group	Pair 1	6 weeks	7.13	1.302	2.867	12.128	0.0001
		3 months	4.27	0.961			
	Pair 2	6 weeks	7.13	1.302	4.8	15.401	0.0001
		6 months	2.33	0.9			
	Pair 3	3 months	4.27	0.961	1.93	16.358	0.0001
		6 months	2.33	0.9			
LCP group	Pair 1	6 weeks	6.93	1.28	2.8	9.459	0.0001
		3 months	4.13	0.743			
	Pair 2	6 weeks	6.93	1.28	4.4	14.402	0.0001
		6 months	2.53	0.99			
	Pair 3	3 months	4.13	0.743	1.6	9.798	0.0001
		6 months	2.53	0.99			

Table 6 shows the comparison of differences in disability score after the surgical intervention in both the DCP and LCP groups. At 6 weeks, the mean disability score in the DCP group was 56.07, which decreased to 32.07 at 3 months. The statistical analysis using a Paired T test showed that this difference in mean disability score, as measured by DASH, was highly significant (P value 0.0001). The DCP group showed a significant reduction in the mean disability score. From 56.07 at 6 weeks, it decreased to 11.93 at 6 months, according to DASH measurements. This difference was found to be statistically significant through a Paired T test (P value 0.0001). At the 3-month mark, the mean disability score in the DCP group was determined to be 32.07. By the 6-month mark, this score had significantly decreased to 11.93, as shown by the DASH measurement. The statistical analysis using the Paired T test confirmed the significance of this difference, with a P value of 0.0001. The average disability score in the LCP group at 6 weeks was 56.13, which decreased to 31.87 at 3 months. This observed difference in mean disability score, as measured by DASH, demonstrated statistical significance according to the Paired T test (P value 0.0001). At 6 weeks, the LCP group displayed a mean disability score of 56.13, which subsequently decreased to 12.33 at 6 months. The difference in mean disability score, as assessed by DASH, was determined to be statistically significant through a Paired T test (P value 0.0001). The average disability score in the LCP group at 3 months was 31.87. It subsequently decreased to 12.33 at 6 months. This reduction in mean disability score, as evaluated by DASH, was found to be statistically significant through a Paired T test (P value 0.0001).

Table 6: Comparison of differences in disability score after the surgical intervention in both the DCP and LCP groups at 6 weeks, 3 months, and 6 months by Paired T test.

Groups	Pairs	DASH score assessment	Mean	Std. Deviation	Mean difference	T value	P value
DCP group	Pair 1	6 weeks	56.07	11.69	24.000	24.717	0.0001
		3 months	32.07	10.00			
	Pair 2	6 weeks	56.07	11.69	44.133	18.652	0.0001
		6 months	11.93	5.20			
	Pair 3	3 months	32.07	10.00	20.133	10.448	0.0001
		6 months	11.93	5.20			
LCP group	Pair 1	6 weeks	56.13	10.66	24.267	25.449	0.0001
		3 months	31.87	9.22			
	Pair 2	6 weeks	56.13	10.66	43.800	24.699	0.0001
		6 months	12.33	4.88			
	Pair 3	3 months	31.87	9.22	19.533	14.265	0.0001
		6 months	12.33	4.88			

Table 7 shows the comparison of differences in pain score between the DCP and LCP group following surgical intervention at 6 weeks, 3 months, and 6 months by Independent T test. At the 6-week follow-up, the mean pain score in the DCP group was found to be 7.13, compared to 6.93 in the LCP group. The Independent T-test results show that the difference in pain score at 6 weeks (0.200) between the two study groups was not statistically significant (p value 0.675). In the DCP group, the mean pain score at the 3-month mark was observed to be 4.27, whereas in the LCP group, it measured 4.13. The observed variation in pain scores at the three-month interval (0.133) between the two study groups did not yield statistical significance through the Independent T test (p value 0.674). The average pain score at 6 months in the DCP group was 2.33, whereas in the LCP group, it was 2.53. The Independent T test (p value 0.567) revealed no statistically significant difference in pain scores at 6 months (-0.200) between the two study groups. There was no notable difference in pain score between the DCP and LCP group at 6 weeks, 3 months, and 6 months following the surgical intervention. Thus, both the DCP and LCP surgical intervention methods showed similar efficacy in reducing pain severity among the participants with Diaphyseal Humerus Fracture.

Table 7: Comparison of differences in pain score between the DCP and LCP group following surgical intervention at 6 weeks, 3 months, and 6 months by Independent T test.

VAS score assessment	Group	Mean	Std. Deviation	Mean difference	T value	P value
6 weeks	DCP group	7.13	1.302	0.200	0.424	0.675
	LCP group	6.93	1.280			
3 months	DCP group	4.27	0.961	0.133	0.425	0.674
	LCP group	4.13	0.743			
6 months	DCP group	2.33	0.900	-0.200	-0.579	0.567
	LCP group	2.53	0.990			

Table 8 shows the comparison of differences in disability score between the DCP and LCP group following surgical intervention at 6 weeks, 3 months, and 6 months by Independent T test. The average disability score at 6 weeks in the DCP group was recorded as 56.07, whereas the average disability score at 6 weeks in the LCP group was noted as 56.13. The Independent T test (p value 0.987) showed that the disparity in disability score at 6 weeks (-0.067) between the two study groups was not statistically significant. At the 3-month assessment, the DCP group displayed a mean disability score of 32.07, in contrast to the LCP group's mean disability score of 31.87. The disparity in disability score at the three-month mark (0.200) between the two study groups did not yield statistical significance according to the Independent T test (p value 0.955). At the 6-month mark, the DCP group exhibited a mean disability score of 11.93, in contrast to the LCP group's mean disability score of 12.33. The Independent T test (p value 0.830) revealed that the disparity in disability score at 6 months (-0.400) between the two study groups was not statistically significant. There was no notable difference in disability score between the DCP and LCP group at 6 weeks, 3 months, and 6 months following the surgical intervention. Thus, the study findings show that both the DCP and LCP surgical intervention methods were equally effective in reducing disability severity among individuals with Diaphyseal Humerus Fracture.

Table 8: Comparison of differences in disability score between the DCP and LCP group following surgical intervention at 6 weeks, 3 months, and 6 months by Independent T test.

DASH score assessment	Group	Mean	Std. Deviation	Mean difference	T value	P value
6 weeks	DCP group	56.07	11.689	-0.067	-0.016	0.987
	LCP group	56.13	10.656			
3 months	DCP group	32.07	10.003	0.200	0.057	0.955
	LCP group	31.87	9.219			
6 months	DCP group	11.93	5.203	-0.400	-0.217	0.830
	LCP group	12.33	4.880			

4. Discussion

The majority of HSFs may be effectively managed by conservative treatment, while some cases may require surgical intervention using plates or intramedullary nails [19]. Plate osteosynthesis is considered the most effective procedure for fixing HSFs when compared with alternative approaches. [20] The use of main plate fixation is preferred in the management of HSFs because of its dependability, rapid mobilization, and capacity to restore normal arm function. [21] Two kinds of implants, namely DCP and LCP, are utilized for the fixation of fractures. Both implants are utilized for the purpose of stabilizing fractures in the humeral shaft. [22] Nevertheless, there is a dearth of comparative research examining the efficacy of these two types of implants in treating fractures in the humeral shaft.

The current study was conducted to compare the clinical and functional outcome of DCP and LCP methods in the management of humeral diaphysis fractures among 30 adult patients in each group. Demographic and other baseline details of the enrolled patients did not differ significantly between the two study groups. In the present study, the mean age of the patients in DCP and LCP groups was 34 ± 7.96 and 32.6 ± 9.24 years respectively and there was no difference in mean age between the groups. There was equal distribution of male and female participants in both the groups. The most common mode of injury was motor vehicle accidents (n = 38).

Patel et al. conducted comparative research in India in 2020 on the treatment of HSF. They made a similar observation. A total of 15 individuals received treatment with LCP, while another 15 patients received treatment with LCDCP [21]. The average age in the LCP group was 33.13 years, whereas in the LCDCP group it was 34.17 years. In the research, Road Traffic Accidents were identified as the primary cause of fracture in 24 instances, accounting for 80% of the total.

In 2022, AM Radha et al. did comparative longitudinal research in India to examine the effectiveness of the LCP technique (used on 20 patients) with the LCDCP method (used on 20 patients) in repairing fractures of the humerus shaft [14]. The baseline features of the research groups were statistically similar ($p > 0.05$). Right-sided damage was prevalent in a large percentage of patients in both the LCP group (55%) and the LCDCP group (65%). Road Traffic Accident was the predominant cause of injury, accounting for 60% of cases. 45% of those in the LCP group experienced direct harm, whereas 90% of individuals in the LCDCP group experienced direct injury.

In both the DCP and LCP groups, the severity of pain and disability significantly decreased six months after the surgical intervention compared to six weeks in the present study. In contrast, the reduction of pain and disability among study participants with a Diaphyseal Humerus Fracture was not substantially different between the two surgical

intervention methods. Statistically, the functional outcomes of the LCP and DCP study groups were comparable, indicating that the outcomes of both surgical procedures are equivalent. No complications were observed in either of the study groups and hence both the methods are noted to be safe.

In 2012, Shen et al. conducted comparative research in China to evaluate the effectiveness of two different implants for restoring mid-distal third humeral shaft fractures. The study utilized minimally invasive plating osteosynthesis (MIPO) techniques [22]. The enrolled patients were categorized into two groups based on the variety of implants used: group A (n = 26), where fractures were stabilized using 4.5-mm DCP, and group B (n = 17), where fractures were stabilized using 4.5-mm LCP. The researchers determined that the use of DCP or LCP led to favorable results. There were no notable disparities in the outcomes of these two types of implants, which coincides with the findings of our study.

In 2020, Patel et al. conducted prospective research in India to assess the results and consequences of diaphyseal fractures of the humerus treated with LCP and LCDCP. A total of thirty patients had treatment using plate osteosynthesis, including fifteen patients in the LCP group and fifteen patients in the LCDCP group [21]. Evaluations were conducted at 6 weeks, 3 months, and 6 months using clinical and radiographic methods. The overall outcomes are nearly identical in both research cohorts. There is no substantial disparity in terms of union, mobilization, hospital stay, blood loss, and complications between the two groups.

In 2022, AM Radha et al. did comparative longitudinal research in India to examine the effectiveness of the LCP technique (used on 20 patients) with the LCDCP method (used on 20 patients) in repairing fractures of the humerus shaft [14]. This study assessed and examined the clinical, functional, and radiological results and problems associated with them. The findings obtained from both research groups were found to be statistically equal, suggesting that the outcomes achieved using both plates are equivalent and may be utilized to treat humerus shaft fractures. Both plates were deemed secure.

In 2019, Khalid et al. conducted a randomized controlled study in Pakistan to examine the functional result of two treatment approaches for humeral shaft non-unions [12]. A total of 75 patients had LCP treatment, while another 75 patients received DCP treatment together with cancellous bone transplants in this research. The functional result was considerably superior in patients with non-union of fractures in the shaft of the humerus when treated with a dynamic compression plate compared to a locking compression plate with cancellous bone graft. The finding was contrary to the conclusions of the investigation we conducted.

5. Limitations

Both groups had a limited sample size, which might affect the statistical power of the research. Additionally, the follow-up period for the patients was shorter than a year. A large-scale randomized controlled trial, ideally triple-blinded or at least double-blinded, is necessary to assess substantial distinctions between DCP and LCP fixation methods in humeral shaft fractures. The study should include a substantial number of patients and have a long-term follow-up period. The study may incorporate other factors such as fracture pattern, time elapsed since injury, concurrent injuries, average surgical duration, radiological results, intraoperative blood loss, average time for mobilization, and average duration of fracture union.

6. Conclusion

The findings demonstrate a significant decrease in pain and disability six months post-surgery for both the DCP and LCP groups, as compared to six weeks post-surgery. The severity of pain and disability experienced by study participants with Diaphyseal Humerus Fractures was not significantly different between the two surgical intervention methods. The statistical equivalence of functional outcomes between the LCP and DCP study groups suggests the outcomes obtained from both surgical procedures are equivalent and can be utilized to treat fractures of the shaft of the humerus. Because of the absence of complications in both study groups, it can be concluded that both procedures are safe. In the case of fractures affecting the shaft of the humerus, plate selection was less significant than the fracture fixation principle.

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