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FUNCTIONAL OUTCOME FOLLOWING ANATOMICAL LOCKING COMPRESSION PLATE BY OPEN TECHNIQUE AND MINIMAL INVASIVE PERCUTANEOUS OSTEOSYNTHESIS (MIPO) TECHNIQUE IN MID SHAFT CLAVICLE FRACTURE

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Abstract

INTRODUCTION: Clavicle fractures are common injuries in adults, accounting for 5% of all fractures and 44% of all shoulder fractures. Furthermore, there is an increasing incidence of complex fracture patterns after high-energy trauma. Incidence in males is usually highest in second and third decade which decreases thereafter as per age. Clavicles mid shaft fractures have classically been treated non-operatively. However, factors including severity of displacement, degree of comminution, and greater than 2 cm of shortening have been reported in the literature to predispose patients to unsatisfactory outcomes with non-operative treatment. Minimally invasive surgery is increasingly being used for the treatment of mid shaft clavicle fracture. The two most commonly used implant are titanium elastic nail (TEN) and locking compression plate (LCP). Minimally invasive percutaneous plate osteosynthesis (MIPPO) is widely used for long bone fracture.

MATERIAL AND METHODS: The patients were selected randomly and were divided in the following two groups of 15 patients each: **Group A:** 15 patients treated by anatomical locking compression plate (LCP) by open technique. **Group B:** 15 patients treated by minimal invasive percutaneous osteosynthesis (MIPO) technique. Follow up period were 1 months, 2months and 6months. Functional outcome was evaluated using the constant shoulder score, which is scored from 0 to 100, with a lower score representing a higher level of functional disability.

RESULTS: Majority of the patients (40%) in Group A were in the age group of 31-40 years followed by 26.7% in the age group of 21-30 years, 20% in the age group 41-50 years and 13.3% in the age group of 51-60 years. The mean age of the patients was 36.2 ± 9.09 years. Majority of the patients in both groups were male. There were 80% and 73.3% male patients in Group A and Group B respectively whereas female patients constituted 20% and 26.7% of the study group respectively. In Group A, 7 (46.7%) patients had operative time of 80-100 minutes whereas 6 (40%) and 2 (13.3%) patients had operative time of 100-120 and 120-140 minutes respectively. The mean operative time was 104.9 ± 13.52mins. In Group B, 6 (40%) patients had operative time of 80-100 minutes whereas 8 (53.4%) and 1 (6.6%) patients had operative time of 100-120 and 120-140 minutes respectively. The mean operative time was 106.5 ± 11.72mins. There was no significant association between the groups as per Student t-test ($p>0.05$).

CONCLUSION: Operative treatment with a LCP for clavicle shaft fractures can be used to obtain stable fixation. Particularly, MIPPO of displaced mid shaft clavicular fractures resulted in a better cosmetic than conventional open reduction, although the functional outcomes were no different between the two groups.

INTRODUCTION:

Clavicle fractures are common injuries in adults, accounting for 5% of all fractures and 44% of all shoulder fractures[i], Most of the clavicular fractures occur in the mid shaft and about half are displaced. Furthermore, there is an increasing incidence of complex fracture patterns after high-energy trauma[ii].Incidence in males is usually highest in second and third decade which decreases thereafter as per age[iii]. In females, it is usually bimodal, with peak incidence in young and elderly. Most mid shaft clavicle fractures generally unite with any method of immobilization. Hence, non-operative treatment was the established and accepted modality of these fractures. This was evident by extremely low nonunion rates shown by various studies done earlier[iv]. Restoration of normal length and alignment by surgical methods can prevent these drawbacks of conservative treatment. Good outcome with high union rates and low complication rates has been

reported with various surgical modalities of primary fixation of the displaced fractures[v],[vi].

Clavicles mid shaft fractures have classically been treated non-operatively. However, factors including severity of displacement, degree of comminution, and greater than 2 cm of shortening have been reported in the literature to predispose patients to unsatisfactory outcomes with non-operative treatment[vii]. Because of these factors, there has been a trend toward operative treatment of clavicle mid shaft fractures. There are various methods for treating clavicle mid shaft fractures, such as intramedullary K-wires or elastic stable intramedullary nailing and plate fixation[viii]. In particular, plate fixation can provide stable anatomical fixation and locking compression plate (LCP), which can be bent to the S-shaped curvature of the clavicle, are the most preferred[ix].

Minimally invasive surgery is increasingly being used for the treatment of mid shaft clavicle fracture. The two most commonly used implant are titanium elastic nail (TEN) and locking compression plate (LCP)[x]. Minimally invasive percutaneous plate osteosynthesis (MIPPO) is widely used for long bone fracture[xi].

Hence the present study was done at our tertiary care centre to evaluate the functional outcome for union in mid shaft clavicle fracture treated with anatomical locking compression plate by open technique and minimal invasive percutaneous osteosynthesis technique.

MATERIAL AND METHODS

A prospective comparative study was conducted with 30 patients to compare and evaluate functional outcome for union in mid shaft clavicle fracture treated with anatomical locking compression plate by open technique and minimal invasive percutaneous osteosynthesis technique. The patients were selected randomly and were divided in the following two groups of 15 patients each: **Group A:** 15 patients treated by anatomical locking compression plate (LCP) by open technique. **Group B:** 15 patients treated by minimal invasive percutaneous osteosynthesis (MIPO) technique.

This study was done in Department of Orthopaedics at Rajarshee Chhatrapati Shahu Maharaj Govt. Medical College and C.P.R Hospital, Kolhapur,from October 2017 to May 2018.

INCLUSION CRITERIA:

Adults above 18 years, Falling into Robinson's type 2 B1 (Mid shaft simple displaced and single butterfly fragment fracture), type 2 B2 (Mid shaft segmental fracture) classification, Patients willing for treatment and giving informed and written consent.

EXCLUSION CRITERIA:

Patient is below 18 years, Fracture of medial third clavicle fracture, Fracture of lateral third clavicle fracture, Patients not fit for surgery, managed conservatively for other medical reasons, All open fracture of clavicle, Immunocompromised status. Patient was informed about the study in all respects and written informed consent was obtained. Follow up period were 1 months, 2months and 6months.

The following investigations were done: X-ray of clavicle with shoulder Antero-posterior view, Complete blood count, Random blood sugar, Blood urea and Serum creatinine, Liver function test, HIV and HbsAg, Blood grouping and Rh- typing, ECG, Chest X-ray- Postero-anterior view.

The conditions of the skin over the clavicle were noted for any abrasion, laceration and contusion. The distal neurovascular statuses of the affected upper limb were examined and also the associated injuries along with fractured clavicle were noted. Plain radiograph of clavicle with shoulder in anteroposterior view was taken to assess the site of fracture, the fracture type (displacement and comminution) and compare on normal side. The fracture were classified according to Robinson's classification.

Fracture fragments were reduced and precontoured locking compression plate was applied over the superior aspect of the clavicle. The precontoured locking compression plate was fixed to the medial and lateral fragment with 4.0 mm locking screw or 3.5mm cortical screw at least three screws in medial and lateral fragment were applied.

Follow up was done at 1 month, 2 months and 6 months. Functional outcome was evaluated using the constant shoulder score, which is scored from 0 to 100, with a lower score representing a higher level of functional disability.

RESULTS

The patients were selected randomly and were divided in the following two groups of 15 patients each. **Group A:** 15 patients treated by anatomical locking compression plate (LCP) by open technique

Group B: 15 patients treated by minimal invasive percutaneous osteosynthesis (MIPO) technique.

Majority of the patients (40%) in Group A were in the age group of 31-40 years followed by 26.7% in the age group of 21-30 years, 20% in the age group 41-50 years and 13.3% in the age group of 51-60 years. The mean age of the patients was 36.2 ± 9.09 years.

Majority of the patients (46.7%) in Group B were in the age group of 31-40 years followed by 33.3% in the age group of 21-30 years, 13.3% in the age group 41-50 years and 6.7% in the age group of 51-60 years. The mean age of the patients was 35.5 ± 8.53 years. There was no significant association between the groups as per Student t-test (p>0.05).

Table 1: Distribution of patients according to Age

Age (yrs)	Group A		Group B		p Value
	N	%	N	%	
21-30	4	26.7%	5	33.3%	>0.05
31-40	6	40%	7	46.7%	
41-50	3	20%	2	13.3%	
51-60	2	13.3%	1	6.7%	
Total	15	100%	15	100%	
Mean ± SD	36.2 ± 9.09		35.5 ± 8.53		

Majority of the patients in both groups were male. There were 80% and 73.3% male patients in Group A and Group B respectively whereas female patients constituted 20% and 26.7% of the study group respectively.

Road Traffic Accident was observedtobethemain cause of fracturein both the groups (53.3% and 60% respectively) followed by fall (46.7% and 40% respectively).

According to Robinson's classification, Type 2B1 and Type 2B2 was seen in 93.3% and 6.7% patients respectively in Group A while Type 2B1 and Type 2B2 was seen in 80% and 20% patients respectively in Group B. There was no significant association between the groups as per Chi-Square test (p>0.05).

Table 5: Distribution of patients according to Robinson's Classification

Robinson's Classification	Group A		Group B		p Value
	N	%	N	%	
Type 2B1	13	93.3%	12	80%	>0.05
Type 2B2	2	6.7%	3	20%	
Total	15	100%	15	100%	

In Group A, 7 (46.7%) patients had operative time of 80-100 minutes whereas 6 (40%) and 2 (13.3%) patients had operative time of 100-120 and 120-140 minutes respectively. The mean operative time was 104.9 ± 13.52mins.

In Group B, 6 (40%) patients had operative time of 80-100 minutes whereas 8 (53.4%) and 1 (6.6%) patients had operative time of 100-120 and 120-140 minutes respectively. The mean operative time was 106.5 ± 11.72mins. There was no significant association between the groups as per Student t-test (p>0.05).

In Group A, majority of the patients (60%) achieved radiological union in <12 weeks while 6 (40%) patients achieved union in 12-24 weeks. The mean duration for radiological union in Group A was 12.7 ± 4.61 weeks. In Group B, majority of the patients (66.7%) achieved radiological union in <12 weeks while 5 (33.3%) patients achieved union in 12-24 weeks. The mean duration for radiological union in Group A was 12.1 ± 6.68 weeks.

Table 13: Functional Outcome of patients during Follow-up Period

Functional Outcome		Group A		Group B		p Value
		N	%	N	%	
Excellent	**At Discharge**	10	66.7%	9	60%	>0.05
	1 month	12	80%	12	80%	
	2 months	13	86.7%	14	93.3%	
	6 months	15	100	15	100%	
Good	**At Discharge**	1	6.7%	2	13.3%	>0.05
	1 month	1	6.7%	1	6.7%	
	2 months	1	6.7%	0	-	
	6 months	0	-	0	-	
Fair	**At Discharge**	2	13.3%	3	20%	>0.05
	1 month	1	6.7%	2	13.3%	
	2 months	1	6.7%	1	6.7%	
	6 months	0	-	0	-	
Poor	**At Discharge**	2	13.3%	1	6.7%	>0.05
	1 month	1	6.7%	0	-	
	2 months	0	-	0	-	
	6 months	0	-	0	-	

DISCUSSION

The clavicle acts as a strut, which transfers power from the trunk to the arm. Fractures of the clavicular shaft were considered to be a domain of non-operative treatment for a long time. This dogma was

based on the studies conducted by NEER CS and Rowe CR in the 1960s[xii].The operative methods for the treatment of clavicle mid shaft fractures involve intramedullary K-wire fixation or Steinmann pin fixation or elastic stable intramedullary nailing and plate fixation. The procedures using the former two materials result in low resistance to torque, carry risks of pin loosening and infection, and require a long term fixation period[xiii].

In the present study, majority of the patients (40%) in Group A were in the age group of 31-40 and majority of the patients (46.7%) in Group B were in the age group of 31-40 years. Majority of the patients in both groups were male. There were 80% and 73.3% male patients in Group A and Group B respectively whereas female patients constituted 20% and 26.7% of the study group respectively. There was no significant association between the groups as per Chi-Square test (p>0.05). This is similar to the studies of Jiang H et al[xiv],Ravi KB et al[xv] and Ethiraj P et al[xvi].

In Group A of our present study, majority of the patients (60%) achieved radiological union in <12 weeks while 6 (40%) patients achieved union in 12-24 weeks. The mean duration for radiological union in Group A was 12.7 ± 4.61 weeks. In Group B, majority of the patients (66.7%) achieved radiological union in <12 weeks while 5 (33.3%) patients achieved union in 12-24 weeks. The mean duration for radiological union in Group A was 12.1 ± 6.68 weeks. There was no significant association between the groups as per Chi-Square test (p>0.05).Jiang H et al[16], Ravi KB et al[17] and Ethiraj P et al[18] noted similar observations in their studies.

It was observed in the present study that during 1 month follow-up period, 12 (80%) patients each in Group A and Group B had excellent score while 1 (6.7%) patient each had good score. Fair score was observed in 1 (6.7%) and 2 (13.3%) patients of Group A and Group B respectively whereas poor score was observed in 1 (6.7%) patient of Group A.

During 2 months follow-up period, 13 (86.7%) and 14 (93.3%) patients in Group A and Group B respectively had excellent score while 1 (6.7%) patient in Group A had good score. Fair score was observed in 1 (6.7%) patient each of Group A and Group B. During 6 months follow-up period, all patients in Group A and Group B had excellent score. There was increase in the functional outcome of patients in both the groups but the increase was statistically not significant (p>0.05). This is similar to the studies of Jiang H et al[16] and Ravi KB et al[17].

CONCLUSION

Operative treatment with a LCP for clavicle shaft fractures can be used to obtain stable fixation. Particularly, MIPPO of displaced mid shaft clavicular fractures resulted in a better cosmetic than conventional open reduction, although the functional outcomes were no different between the two groups.

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