Print ISSN: 2958-3675 | Online ISSN: 2958-3683
International Journal of Medical and Pharmaceutical Research
Available Online at https://ijmpr.in/
ORCiD ID: 0000-0002-3849-6959
Volume 4, Issue 1; (2023); Page No. 134-139
Original Article
Open Access

A Comparative Study Between Conventional Tension Band Wiring With Two K-Wires And Tension Band Wiring With Single Cancellous Screw For Fixation Of Mayo Type IIA Olecranon Fracture

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ABSTRACT

Background: Olecranon fractures are one of the most commonly seen orthopaedic injuries in the emergency room. Open reduction and internal fixation are usually required to obtain an anatomical realignment of the articular surface and to restore the normal elbow function. **Objectives**: To compare the functional outcome of conventional tension band wiring with two K-wires and tension band wiring with single cancellous screw for fixation of Mayo type II A olecranon fracture. **Methods**: This prospective observational study was conducted in the Department of Orthopaedic surgery, BSMMU, Shahbag, Dhaka, Bangladesh from October 2017 to September 2019. Within the period, total 60 cases of Mayotype IIA olecranon fracture patients were selected who needed operative treatment. Mayo Elbow Performance Score was used to assess the outcome of surgery. All the data were analyzed statistically by using statistical package for social science (SPSS-25). The results were expressed as frequency, percentage and mean ± SD. Level of significance was calculated at 95% CI and $p<0.05$. **Results**: The results of present study demonstrate that the postoperative means (±SD) pain, motions, stability and function of MEPS were 32.50±10.31,18.33±2.36,8.33±2.36 and 17.83±5.58 respectively in conventional TBW with two K-wires group, 35.00±8.94;19.00±2.00;8.17±2.41and 15.00±2.89 respectively in TBW with single cancellouss crew group. Postoperative MEPS was improved more than preoperative MEPS score in TBW with single cancellous screw group than conventional group. But these differences were not statistically significant in case of pain, motions and stability but significant for improvement of function. A total number of 20 (66.7%) & 26 (86.7%) patients were in the satisfactory group and only 10(33.3%) & 4 (13.3%) patients were in the unsatisfactory group respectively. **Conclusion**: It can be concluded that tension band wiring with single cancellous screw showed better functional outcome and stability, reduced complications and hospital stay than conventional tension band wiring with two K-wires procedure for fixation of olecranonfracture.

Keywords: *Mayo TypeII Olecranon Fracture, TBW, K-Wire, Cancellous Screw.*

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INTRODUCTION

Olecranon fractures are common injuries of the proximal ulna. Fracture of the elbow accounts for up to 7% of all fractures in adult with approximately 37% affecting only olecranon [1]. Most olecranon fractures follow low-energy trauma such as a fall from a height of less than 2 meters, a direct blow to the elbow, or from forced hyperextension [2]. Afall on a partially flexed elbow may generate an avulsion fracture of the olecranon from the pull of the triceps. The fractures are usually isolated but associated lesions can occur in complex injuries and polytrauma cases [3]. Different classification methods are present to assess the fracture patterns, among which Mayo's classification system is considered to be the most commonly used. They depend on the degree of fracture displacement, the stability of the elbowjoint and communition at the fracture site. Un displaced fractures are Mayo Type I fractures and these are exceptional and can be managed conservatively. However, most olecranon fractures are

displaced, considered as Mayo Type II and Type III, and in such cases operative treatment is recommended. The aim of fracture treatment is to restore early, active, elbow motion in order to prevent joint stiffness [4, 5]. Open reduction and stable internal fixation with the anatomical reduction of the articular surface is the gold standard for olecranon fracture treatment. Various fixation techniques have been used for olecranon fracture treatment, including tension band wiring, intramedullary screws, plate and screw fixation, rush pins, small specially designed olecranon nails and simple fragment excision with re-attachment of the triceps tendon [5]. Fracture olecranon in children accounts for approximately 4–7% of all elbow fractures and the degree of displacement, location, pattern of the fracture, and associated injuries influence the method of treatment. The majority of these injuries can be successfully managed with cast immobilization, but when significant displacement is encountered, surgical intervention is recommended There has been a trend to apply the guidelines used in the management of adult olecranon fractures to the treatment of similar fractures in children [5,6]. Tension band wiring (TBW) is the gold standard fixation for treating Mayo type IIA olecranon fracture. It involves the use of a tension band and two K wires. However, a number of complications such as infection, non-union, malunion and ulnar nerve palsy could compromise the effect of operative treatment in up to 10% of cases. The most common are hardware prominence which requires removal, loss of motion and loss of fixation. The K-wire is used to resists the shear better than the figure of eight wire alone, but, it does not add compression to the fixation strength. But, a cancellous screw plus a Tension Band Wire (TBW) in combination, provides the strength of fixation by converting the tensile force to a compressive force at the fracture site, with additional resistance to the displacement due to the lag screw compression [7,8,9]. Previous studies reported that the technique of open reduction and internal fixation with a cancellous screw and TBW, is a simple and effective means of treating fractures of the olecranon and it is based on the biomechanical principle of sound [8,9], but data was not adequate for established safety and satisfactory outcome of TBW with single cancellous screw. Therefore, present study has been design to compare the functional outcome of conventional tension band wiring with two K-wires and tension band wiringwith single cancellous screw for fixation of Mayo type IIA olecranon fracture.

MATERIALS ANDMETHODS

Study design: Prospective study. Types of study: Observational study.
Study period: October 2017 to September 2019.
Place of study: This study was carried out in the department of Orthopaedic Surgery at BSMMU, Shahbag, Dhaka, Bangladesh.
Ethical issue: Ethical clearance was obtained from the Institutional Review Board (IRB) of BSMMU.Sample: Mayo type IIA olecranon fracture patients who need operative treatment.
Sample size: So, finally sample size were 34 in each group.
Grouping of the study population: A total number of 68 patients were purposively divided into two groups. Group-A: Consisted of 34 patients who were receiving tension band wiring with two K-wires for fixation of Mayo type IIA olecranon fracture. Group-B: Consisted of 34 patients who were receiving the functional outcome of tension band wiring with single cancellous screw for fixation of Mayo type IIAolecranon fracture.
Study population: Patients attending at the department of Orthopaedic Surgery at BSMMU, Shahbag, Dhaka with theMayo type IIA olecranon fracture.

Inclusion criteria:

1. Age between 18 to 60 years.
2. Both sexes.
3. Patients with Mayo type IIA olecranon fracture diagnosed radiologically.

Exclusion criteria:

1. Age < 18 years and >60 years.
2. Patients with concomitant fracture in the injured extremity.
3. Patients with olecranon fracture extend distal to the coronoid process.
4. Open olecranon process, fractures associated with dislocations and fractures with duration of injury more than 3 weeks.
5. Fractures with associated head injury.
6. Previous injury or illness in the injured upper extremity with permanent reduced elbow function.

Study Procedure: Patients attending at the department of Orthopaedic Surgery at BSMMU, Shahbag, Dhaka with Mayo type IIA olecranon fracture were considered and advised for this surgery. The patients were selected on the basis of the inclusion and exclusion criteria. The patients were diagnosed clinically and radiologically. After taking inform consent, detail history and physical examination of each patient were performed. A structured case record form was used to interview and collect data. Patients were interviewed and case record form was filled up by the interviewers. Patients were assessed properly both clinically and radiologically and preoperative planning were done for fixation of fracture. Fixation were done by using tension band wiring with two K-wires in group A and tension band wiring with single cancellous screw in group B. Outcome of fixation were assessed by measuring pain, range of motion, stability and function according to Mayo Elbow Performance score. All the data were compiled and sorted properly and the quantitative data were analyzed statistically by using Statistical Package for Social Science (SPSS-25). The results were expressed as percentage and mean ±SD. $p<0.05$ were considered as the level of significant. Comparisons of continuous variables between the two groups were made with Paired Student‟s t-tests. Comparison of proportions between two groups was made with Chi-Square tests.

Statistical analysis: All the data were compiled and sorted properly and the numerical data were analyzed statistically by using Statistical Package for Social Science (SPSS-25). The results were expressed as frequency and percentage and mean ±SD. Level of significance was calculated at 95% confident interval (CI) and $p<0.05$. Comparisons of continuous variables between the two groups were made with Unaired Student‟s „t‟ test. Comparison of proportions between two groups was made with Chi-Square tests.

RESULTS

A total number of 60 patients of Mayo type IIA olecranon fracture requiring surgery that met the inclusion criteria were selected. In group A, out of 30 patients, 11 (36.7%) were 18-30 years of age, 12 (40%) were 31-45 years of age and 7 (23.3%) were 46-60 years old & mean age was 36.06 12.20 years In group B, out of 30 patients, 10 (33.3%) were 18-30 years of age, 14 (46.7%) were 31-45 years of age and 6 (20%) were 46-60 years old & mean age was 36.30±11.89 years. The youngest and the oldest patients were 18 and 60 years respectively in both groups. No significant differences were observed between the groups. Among 60 subjects, majority (66.7% & 60%) of the study subjects were male and only 10 (33.3%) & 12 (40%) were female in both groups. No significant differences were observed between the groups. In group A, out of 30 patients 6 (20%) had history of fall from height, 10 (33.3%) had history of direct injury and 14 (46.7%) had history of road side accident. In group B, out of 30 patients 7 (23.3%) had history of fall from height, 11 (36.7%) had history of direct injury and 12 (40%) had history of road side accident. No significant differences were observed between the groups. Among 60 subjects, majority (60% & 66.7%) of the study subjects had right sided injury and only 12 (40%) & 10 (33.3%) had left sided injury in both groups. No significant differences were observed between the groups. Among 60 subjects, duration of injury of majority (66.7% & 60%) of the study subjects were <1weeks and only 10 (33.3%) & 12 (40%) of the study subjects were ≥1weeks in both groups. Mean duration was 6.83±4.82 & 5.60±5.15 respectively. No significant differences were observed between the groups (Table-1).

In 14 (46.7%) cases duration of union were 10 - 12 weeks, in 10 (33.3%) cases duration of union were 13 - 14 weeks while only 6 (20%) cases duration of union was >14 weeks up to 16 weeks in Group A with mean duration was12.36±1.92 weeks. And in 12 (40%) cases duration of union were 10 - 12 weeks, in 11 (36.7%) cases duration of union were 13 - 14 weeks while in 7(23.3%) cases duration of union was >14 weeks up to 16 weeks in Group B according to radiology. Mean duration of union was 12.46±2.04 weeks. No significant differences were observed between the groups (Table-2).

The preoperative means (±SD) pain, motions, stability and function of MEPS were 8.00± 2.48, 6.00 ± 3.00, 2.67 ± 2.49 and 8.50 ± 3.45 respectively in group A, 6.60 ± 2.23, 6.67± 3.73, 2.00 ± 2.45 and 7.17 ± 2.48 respectively in group B. No significant differences were observed preoperatively between the groups (Table-3).

The postoperative means (±SD) pain, motions, stability and function of MEPS were 32.50± 10.31, 18.33 ± 2.36, 8.33 ± 2.36 and 17.83 ± 5.58 respectively in group A, 35.00 ± 8.94; 19.00± 2.00; 8.17 ± 2.41 and 15.00± 2.89 respectively in group B. Postoperative MEPS was improved more than preoperative MEPS score in Group B than Group A. But these differences were not statistically significant in case of pain, motions and stability but significant for improvement of function (Table-4).

The outcome of the subjects was graded according to MEPS as excellent in 4 (13.3%) & 9 (30.0%), good in 16 (53.3%) & 17 (56.7%), fair in 7(23.3%) & 3(10.0%) and poor in 3 (10.0%) & 1 (3.3%) patients in both groups. No significant differences were observed between the groups (Table-5).

In this study, during the course of the study only 4 (13.3%) & 2 (6.7%) patients developed superficial infection and 4 (13.3%) & 2 (6.7%) patients developed symptomatic metal prominence in both groups respectively. But only 2 (6.7%) patients developed secondary dislocation and the proximal migration of the K-wires causing pain, perforation of the skin and local inflammation (Table-6).

To determine the final outcome of the study, excellent and good grades were treated as satisfactory fair and poor grade was treated as unsatisfactory according to MEPS. So, a total number of 20 (66.7%) & 26 (86.7%) patients were in the satisfactory group and only 10 (33.3%) & 4 (13.3%) patients were in the unsatisfactory group respectively. No significant differences were observed between the groups. Out of 30 patients, 20 (66.7%) found to have satisfactory results in patients who received TBW with K-wires (Table-7).

Table-1: Demographic characteristics of the patients (N=60)

	Group A (n=30)	**Group B(n=30)**
Age (years)		
18-30	11(36.7%)	10(33.3%)
31-45	12(40%)	14(46.7%)
46-60	7(23.3%)	6 (20%)
Mean ± SD	36.06 ± 12.20	36.30 ± 11.89
Sex		
Male	20(66.7%)	18(60%)

Female	10(33.3%)	12(40%)
Mechanism of injury		
Fall from height	6(20%)	7(23.3%)
Direct injury	10(33.3%)	11(36.7%)
Road traffic accident	14(46.7%)	12(40%)
Side of injury		
Left	12(40%)	10(33.3%)
Right	18(60%)	7(23.3%)
Road traffic accident	14(46.7%)	12(40%)
Duration of injury		
<1 weeks	20(66.7%)	18(60%)
≥1 weeks up to 3 weeks	10(33.3%)	12(40%)
Mean ± SD	6.83±4.82	5.60±5.15

Table-2: Distribution of study population according to duration of union of fracture by radiology (N=60)

Duration of union	Group A (n=30)	Group B(n=30)	P Value
10-12 Weeks	14(46.7%)	12(40%)	
13-14 weeks	10(33.3%)	11(36.7%)	0.870^{ns}
>14 weeks up to 16	6(20%)	7(23.3%)	
Mean ± SD	12.36±1.92	12.46±2.04	

Table-3: Assessment of the study population by preoperative Mayo Elbow Performance Score (MEPS) (N=60)

MEPS	Group A(n=30)	Group B(n=30)	Mean difference	95% CI	p value
Pain	8.00 ± 2.48	6.60 ± 2.23	1.400	-5.202 to 2.402	0.464ns
ROM	6.00 ± 3.00	6.67 ± 3.73	0.670	-1.079 to 2.419	0.446ns
Stability	2.67 ± 2.49	2.00 ± 2.45	0.670	-1.947 to 0.607	0.298ns
Function	8.50 ± 3.45	7.17 ± 2.48	1.330	-2.883 to 0.223	0.092ns

Table-4: Assessment of the study population by postoperative Mayo Elbow Performance Score (MEPS) (N=60)

MEPS	Group A(n=30)	Group B(n=30)	Mean difference	95% CI	p value
Pain	32.50 ± 10.31	35.00 ± 8.94	2.500	-2.487 to 7.487	0.320ns
ROM	18.33 ± 2.36	19.00 ± 2.00	0.670	-0.460 to 1.800	0.240ns
Stability	8.33 ± 2.36	8.17 ± 2.41	0.160	-1.393 to 1.073	0.796ns
Function	17.83 ± 5.58	15.00± 2.89	2.830	-5.127 to -0.533	0.017s

Table-5: Distribution of study population according to Mayo Elbow Performance Score (N=60)

MEPS	Grading	Group A (n=30)	Group B(n=30)	P Value
Excellent	> 90	4(13.3%)	9(30.0%)	
Good	75-89	16(53.3%)	17(56.7%)	0.207ns
Fair	60-74	7(23.3%)	3(10.0%)	
Poor	<60	3(10.0%)	1(3.3%)	

Table-6: Distribution of study population according to complications (N=60)

Parameters	Group A (n=30)	Group B(n=30)
Superficial infection	4(13.3%)	2(6.7%)
Symptomatic metal prominence	4(13.3%)	2(6.7%)
Secondary dislocation	2(6.7%)	0(0%)

Table-7: Distribution of study population according to functional outcome (N=60)

Outcome	Group A (n=30)	Group B(n=30)	P value
Satisfactory	20(66.7%)	26(86.7%)	0.067^{ns}
Unsatisfactory	10(33.3%)	4(13.3%)	

DISCUSSION

The results of current study demonstrate that most common age that is 40% of group A and 46.5% of group B patients were between 31 to 45 years age group. Mean age were 36.06±12.20 in group A and 36.30±11.89 for group B. The youngest and the oldest patients were 18 and 60 years respectively in both groups. These are similar to the findings of Ahmed et al. [8] where the mean age was 37.90±18.50 years and age range was from 17 to 70 years. But these findings differ from findings observed by Chalidis et al. [10] & Schneider et al. [11] which may be due to demographic variation of younger working people in our country. Most of the cases male population were suffered and that was 66.7% in group A & 60% in group B. Almost similar

to the findings observed by Lu et al [12] in which 57 out of 88 patients were male (64.77%) and Bhattacharyya et al. [3] observed 26 out of 40 patients (65%) were male. In this study most common mechanism of injury was Road traffic injuries that were 46.7% in group A and 40% in group B. Second common mechanism was direct injury that were 33.3% in group A and 36.7% in group B. Rest of the patient had history of fall from height. Langshong et al. [13] observed similar findings with 75% injury from road traffic accident. But Chalidis et al. (2008)[10] had different observations where only 14.5% had road traffic injury, 24.2% had historyof fall from height and most common 61.3% had simple fall onto the arm. Villanueva et al. [14] also differs by 81% of simple fall, 8% of direct injury &only 6% of road traffic accident. These findings may be due to increased use of traffic in our day to day life. 60% of group A and 66.7% of group B patients had injury on right side. This finding was similar to findings of Raju et al. [9] in which 80% patients had injury on right side. Yan M Aher et al. [15] also observed similar findings which is 80% injury on right side. Bhattacharyya et al. [3] also had similar 70% patients with right sided injury. In Our study 66.7% of group A and 60% of group B patients had duration of injury less than 1week. Rest of them had duration of injury >1week to 3weeks. Mean duration were 6.83±4.82 & 5.60±5.15 days respectively. This is similar to Ahmed et al. [8] where mean duration was 6±4.1 days with range of 1 to 13 days. This is also nearly similar to Raju et al. [9] where ranges of duration were from day 1 to day 13. In this study in 46.7 % of group A and 40% of group B patients duration of fracture union radiologically were between 10-12 weeks with mean duration of 12.36±1.92 & 12.46±2.04 weeks. Whereas in 23.3% of group B and only 20% of group A fracture union achieved from >14 weeks to 16 weeks. Lu et al. [12] also had nearly similar results where group B had mean union time of 11.38±1.2 weeks and group A had 12.6±1.8 weeks. But results differ from Ahmed et al.[8] where mean time of union in group A was 7.1±1.7 and in group B was 7±1.6 with range of 6 to 12 weeks. In present study, each patient was assessed pre and postoperatively by pain, motions, stability and function. No significant differences were observed in the preoperative mean (±SD) pain intensity, motion, stability and function of MEPS in both groups. This finding was in agreement with the study of many researchers of different countries [12,16,17]. In present study, postoperative MEPS was improved more than preoperative MEPS score in TBW with single cancellous screw than TBW with k-wire group. 13.3% patients of group A and 30% patients of group B had excellent result in MEPS. 53.3% patients of group A and 56.7% patients of group B had good result in MEPS. 23.3% of group A and 10% of group B had fair result. Poor result observed in 10% of group A and 3% of group B patients. There was statistically significant mean difference of function between two groups where group B showed better outcome. This finding was agreement with the study of many researchers of different countries [12,16,17]. During the course of the study only 2 patients (6.7%) developed superficial wound infection and 2 patients (6.7%) developed symptomatic metal prominence in tension band wiring with single cancellous screw. However, 4 patients (13.3%) developed superficial wound infection and 2 patients (6.7%) developed symptomatic metal prominence and 2 patients (6.7%) developed secondary dislocation and the proximal migration of the K wires causing pain, perforation of the skin and local inflammation in conventional tension band wiring with two K-wires. This finding was in agreement with Raju et al [9] where 8% complications of both superficial wound infection and symptomatic metal prominence were observed. Similar findings were observed by Murphy et al [18], Suchinder et al [19], but disagreement with Lu et al [12] where there were 19.5% complications in group A and only 4.7% complications in group B. This disagreement may be due to environmental and nutritional variations.

CONCLUSION

After analyzing the results of the present study, it can be concluded that tension band wiring with single cancellous screw showed better functional outcome and stability, reduced complications and hospital stay than conventional tension band wiring with two K-wires procedure for fixation of Mayo type IIA olecranon fracture. Based on the study finding and review of current literature, it can be demonstrated that tension band wiring with single cancellous screw procedure can be recommended in fixation of olecranon fracture.

LIMITATIONS

Although optimal care had been tried by the researcher in every steps of the study, but there were some limitations:

- Study was conducted in a single hospital. So, the study population might not represent the whole community.
- The sample was taken purposively. So, there may be chance of bias which can influence the results.
- The study and follow-up period was short in comparison to other studies.
- Small sample size.

RECOMMENDATIONS

To make more conclusive results the following recommendations are proposed for further studies:

- Multicentre based study should be done to get more appropriate results.
- Similar type of study can be done with large sample size.
- Study must be longer period. So that we find out the effect of treatment in maximum outcome.

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