

FUNCTIONAL OUTCOMES OF TENS VS PLATING AS TREATMENT MODALITIES IN DIAPHYSEAL FRACTURE OF BOTH BONE FOREARM

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Received : 10/07/2024
Received in revised form : 09/09/2024
Accepted : 25/09/2024

Keywords:
Functional outcomes, treatment modalities, fractures, forearm.

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DOI: 10.47009/jamp.2024.6.5.176

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (5); 916-920



Abstract

Background: The aim of the present study was to assess the functional outcomes of TENS vs plating as treatment modalities in fractures of both bone forearm. **Materials and Methods:** The study was carried out at Department of Orthopaedics, Era's Lucknow Medical College & Hospital, Lucknow. Being a tertiary care centre with state-of-the-art infrastructure catering primarily to socio-economically underprivileged suburban and rural population of Lucknow for the period of 24 months. We collected the medical records of only 32 patients. **Result:** Age of patients ranged from 14 to 68 years; mean age was 31.28±18.74 years. Only 8 (25.1%) patients were aged between 14-20 years. Out of 32 patients enrolled in the study 22 (68.8%) were males and left arm was involved in 19 (59.4%) cases, in rest of the cases right arm was involved. Most common mode of injury was Road traffic accident (RTA; 75%), injury due to fall was reported by 5 (15.6%) patients. Majority of the patients presented with Simple fractures (68.8%), 9 (28.1%) had Wedge shaped fracture, only 1 (3.1%) patient presented with Complex fracture. Two treatment modalities have been used in the present study, 16 (50%) with CRIF with TENS and rest 16 (50%) with ORIF with plating. Patients treated with ORIF with plating were older (53.09±10.05; 38-68 years). Difference in age of patients of above two groups was significant statistically. **Conclusion:** The findings of the study showed that all the treatment modalities used in the present study achieved excellent or satisfactory outcomes with minimal complications.

INTRODUCTION

Forearm fractures are amongst some of the common sites of fracture, particularly in children. It affects approximately one in every 100 children each year, thus showing its annual incidence to be 1% in pediatric age group. Children aged 5 to 14 years are one of the most commonly affected age group, comprising nearly one-third of total cases in this population. Among adults they are less frequent, with a bimodal age distribution showing peaks before age 40 and after age 60. There is an age-related predisposition of both bone forearm fractures with affected women being older as compared to men. In women maximum both bone forearm fractures take place after the age of 60 years. Overall, among adults, however, those aged 25-34 years are amongst the most commonly affected ones.^[1,2]

Young adolescents participating in sports activity and physically active individuals are at an increased risk of both forearm fractures.^[3,4] The forearm consists of two relatively parallel bones (radius and the ulna) that extend between elbow at the one end and wrist at the other hand. The two bones of the forearm function to allow flexion and extension at the elbow as well as at the wrist via diarthrodial joints. Apart from this, “these two bones themselves form joints that help in supination and pronation; therefore, forearm fractures are considered intra-articular fractures. Proper management of such fractures is necessary to restore forearm functions, including supination and pronation, elbow and wrist movements, and handgrip strength.^[5,6]

Forearm diaphyseal fractures constitutes around 6% of all other children's fractures.^[7] The standard management of these fractures remains conservative treatment with closed manipulation and

immobilization with an above-elbow plaster cast for 4–6 weeks.^[8] The most common complication remains fracture re-displacement which can lead to malunion, causing impairment of forearm rotation.^[9] Other modalities of treatment have been proposed for the treatment of both-bone forearm fractures in children and adolescents such as closed reduction and K-wire fixation, titanium elastic nailing system (TENS), and open reduction with plate fixation. Biomechanically, these implants have shown to act as internal splints.^[10] However, as per recent literature, pediatric forearm fractures, in particular, have seen an increased rate of surgical treatment despite the lack of comparative studies showing a clear benefit over non-operative treatment.^[11,12] The aim of the present study was to assess the functional outcomes of TENS vs plating as treatment modality in fractures of both bones forearm.

MATERIALS AND METHODS

The study was carried out at Department of Orthopedics, Era's Lucknow Medical College & Hospital, Lucknow. Being a tertiary care center with state-of-the-art infrastructure catering primarily to socio-economically underprivileged suburban and rural population of Lucknow for the period of 24 months. We collected the medical records of only 32 patients.

Sampling Frame

Data from Medical Records Department (MRD) of patients treated in the Department of Orthopedics, Era's Lucknow Medical College & Hospitals, Lucknow during January 1st, 2018 to January 1st, 2020 were analyzed. The sampling frame of the study was bound by the following inclusion and exclusion criteria:

Inclusion Criteria

- Patients with diaphyseal both bones forearm fractures.
- Aged between 14-70 years.

Exclusion Criteria

- Patients who did not give consent to participate in the study
- Open/Compound fractures
- Presence of neurovascular deficit
- Presence of other fractures of arm, elbow, wrist or hand

Clearance and Approvals

Clearance for carrying out the study was obtained from the Institutional Ethical Committee, Era's Lucknow Medical College & Hospital, Lucknow. An informed consent was obtained from all the patients.

Methodology

After getting clearance from Medical Ethics Committee medical records of patients were collected from Medical Records Department. Demographic Details, mode of injury, side affected and other clinical parameters required in the study were recorded.

Functional outcomes were assessed according to Anderson et al Score and DASH score.

Anderson et al Scoring System

Result	Union	Flexion and extension at wrist joint	Supination And Pronation
Excellent	Present	<10° loss	<25% loss
Satisfactory	Present	<20° loss	<50% loss
Unsatisfactory	Present	<30° loss	>50% loss
Failure	Non-union with or without loss of motion		

Level of disability was assessed using the disabilities of the arm, shoulder and hand (DASH) questionnaire. The main part of the DASH is a 30- item disability/symptom scale concerning the patient's health status during the preceding week. The items ask about the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptoms of pain, activity-related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item has five response options. The scores for all items are then used to calculate a scale score ranging from 0 (no disability) to 100 (most severe disability). The score for the disability/symptom scale is called the DASH score. In the present study we used the Swedish version of the DASH.

Data obtained from the Medical Records were recorded on a Master chart on MS-Excel sheet which was later used for analysis. The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 21.0 Statistical Analysis Software. The values were represented in Number (%) and Mean±SD. Chi-square test was used to test the significance of categorical data while to test the significance of two mean values student 't' test was used. Level of significance was p<0.05.

RESULTS

Age of patients ranged from 14 to 68 years; Only 8 (25.1%) patients were aged between 14-20 years, majority of patients were aged 21-30 years (27.9%), only 6 (18.8%) were above 50 years of age. Out of 32 patients enrolled in the study, 22 (68.8%) were males, rest were females. Out of 32 patients left arm was involved in 19 (59.4%) cases, in rest of the cases right arm was involved. Most common mode of injury was Road traffic accident (RTA; 75%), injury due to fall was reported by 5 (15.6%) patients. Injury due to assault has been reported by 3 (9.4%) patients. Majority of the patients present with Simple fractures (68.8%), 9 (28.1%) had Wedge shaped fracture, only 1 (3.1%) patient presented with Complex fracture. Out of 32 patients all the patients except 4 (12.4%) were managed without any complications. In these 4 patients, infection was noticed in plating patients, while delayed union and malunion in TENS patients. Two treatment modalities were used in the present

study, 16 (50%) with CRIF with TENS and rest 16 (50%) with ORIF with plating.

Outcome of only 2 (6.2%) patients was unsatisfactory, 7 (21.9%) patients had satisfactory outcome. Majority of the patients had excellent functional outcome.

Range of DASH score of patients was 0 to 43.25, mean DASH score was 10.83±10.80. Median DASH score was 7, IQR (1.75-18.06).

Patients treated with ORIF with plating were older (53.09±10.05; 38-68 years). Difference in age of patients of above two groups was significant statistically.

Proportion of patients with Excellent Anderson's score was higher in those treated with CRIF with TENS and ORIF with plating.

Table 1: Demographic data.

Age Group	Number of cases	Percentage
14-20Years	8	25.1
21-30Years	9	27.9
31-40Years	4	12.6
41-50Years	5	15.6
51-60Years	3	9.4
61-70Years	3	9.4
Sex		
Male	22	68.8
Female	10	31.2
Side involved		
Left	19	59.4
Right	13	40.6
Mode of injury		
RTA	24	75.0
Assault	3	9.4
Fall	5	15.6
Type of fracture		
Simple	22	68.8
Wedge	9	28.1
Complex	1	3.1

Table 2: Complications and treatment modality

Complications	Number of cases	Percentage
No Complication	28	87.5
Malunion	1	3.1
Delayed union	1	3.1
Infection	2	6.2
Treatment modality		
CRIF with TENS	16	50
ORIF with plating	16	50

Table 3: Clinical and Functional Outcome as per Anderson criteria.

Outcome	Number of cases	Percentage
Excellent	23	71.9
Satisfactory	7	21.9
Unsatisfactory	2	6.2

Table 4: Functional Outcome as per DASH Score.

Variables	Statistic
Minimum	0
Maximum	43.25
Mean	10.83
Standard deviation	10.80
Median [Interquartile range]	7[1.75-18.06]

Table 5: Comparison of Demographic and clinical profile among the treatment modalities

Characteristic	CRIF with TENS(n=16)	ORIF with plating(n=16)	Statistical significance
Mean age±SD (Range)in years	27.00±8.17 (14-45)	53.09±10.05 (38-68)	F=66.96; p<0.001
Male: Female	12:4	10:6	$\chi^2=5.300$; p=0.071
Side involved			
Left	10	9	$\chi^2=2.754$; p=0.252
Right	6	7	
Modeofinjury			
RTA	14	10	$\chi^2=14.012$; p=0.007
Assault	2	1	
Fall	-	5	

Fracture type			
Simple	12	10	$\chi^2=4.594; p=0.332$
Wedge	4	6	
Complex	1	0	
Complications			
None	14	14	$\chi^2=4.0$ $p=0.261$
Delayed Union	1	0	
Malunion	1	0	
Infection	0	2	

Table 6: Association of Anderson's scores with Treatment Modality

Anderson's score	Treatment modality	
	CRIF with TENS(n=16)	ORIF with Plating (n=16)
Excellent	12	11
Satisfactory	4	3
Unsatisfactory	0	2
$\chi^2=2.18633; p=0.335$		

DISCUSSION

The goal of treatment for forearm fracture is to ensure maintenance of optimal length and radioulnar joint relationships with full pronosupination.^[13-15] There are various options for treating such fractures, including closed management and surgical interventions. Decisions regarding treatment are based on factors such as fracture pattern, patient age, and soft-tissue envelope integrity.^[15,16]

The age of patients ranged from 14 to 68 years with a mean age of 31.28±18.74 years. Majority of patients were males (68.8%). Mean age of patients in the series of Zhang et al,^[17] was 38.03±0.88 years and majority of their patients were also males (54%), thus showing a slightly higher mean age and a slightly lower proportion of males. In the present study, road traffic accident (RTA) was the most common mode of injury (75%) while assault (9.4%) was the least common injury. Diaphyseal fractures can occur owing to varied modes, however, most of the contemporary studies similar to our study report a dominance of those occurring due to RTA and assault among the least common modes of injury.^[18,19]

In our series, a total of two modalities were used. A total of 16 (50%) were managed by open reduction with internal fixation (ORIF) using plating. Remaining 16 (50%) were managed using closed reduction and internal fixation using TENS. Compared to the present study, Zhang et al,^[17] reported use of both-bone plate fixation (n=21), both-bone intramedullary nailing (n=22), plate fixation of ulna and intramedullary nailing of radius (n=21) and intramedullary nailing of ulna and plate fixation of radius (n=23) but did not use the conservative management by cast. Zeybek et al,^[20] in their study among paediatric patients reported use of plate-screw, ESIN and hybrid in 37.3%, 35.3% and 27.5% patients respectively.

In the present study, most of the fractures were Simple (68.8%), 3.1% had complex fracture and 28.1% had wedge shaped fracture. Prakash et al,^[18] reported simple fracture pattern in 39.3% and simple wedge pattern in 24.5% of their cases. In the present study, all the cases were unilateral and left side

(59.4%) was more commonly involved than the right side (40.6%). Although June et al,^[19] in their study also found all the cases as unilateral, however, in their study right side (60%) was more commonly involved than the left side (40%).^[20] In the present study, all the patients had minimum follow-up period of 12 months. Goyal et al,^[21] too reported follow-up duration of one year similar to ours. A number of other studies also assessed functional outcome among patients with a minimum follow up duration of one year.^[22,23]

In the present study, no complication was observed in majority (87.5%) cases. Delayed union and Malunion were observed in only 1 (3.1%) patient each in TENS group. Infection was observed in 2 (6.2%) patients in plating group. Goyal et al,^[21] in their study on patients managed using TENS reported superficial infection as early complication in 6.7% patients. They also reported malunion in one (3.3%) patient. There was no infection in nailing group. It may be because all the surgeries in this group were performed by closed reduction under image intensifier, but malreduction of radial bow was noted. Khaja et al,^[24] showed in his study that Percentage of excellent results was higher in plating when compared to nailing group. Restoration of pronation and supination depends upon the anatomical alignment and restoration of normal bow. As the nailing was performed after closed reduction so normal radial bow could not be restored, causing less percentage of excellent results in nailing group, although regaining of the normal flexion and extension of elbow and wrist joint was achieved. Also, unlike compression plating, intramedullary devices are stress sharing rather than stress shielding, which leads to peripheral periosteal callus that may facilitate the stronger fracture union. In the present study, excellent, satisfactory and poor/unsatisfactory results were seen in 71.9%, 21.9% and 6.2% cases respectively. However, Singh et al,^[25] reported excellent outcome in only 52.2% and 47.6% of patients in two groups treated by TENS and K-wire respectively but still these results were comparable in the two study groups. In the present study, mean DASH score was 10.83±10.80, a similar DASH score among adult patients managed using IM nails after a

minimal follow-up period of 12 months was also reported by Saka et al,^[23] who had 65.1% patients with both bone forearm fractures.

The present study found a strong and significant correlation between functional and disability scores. This establishes the relationship that better functional outcomes reduce the disability. In the present study, on univariate analysis, only complications and disability were found to be significantly associated with poor outcome. As such the association between disability and functional outcome seems to be temporal and needs no further exploration. With respect to association of complications with poor outcome, the same could be explained on the grounds that in this study only long-term complications having an impact on the outcome were taken into consideration. In the present study, multivariate analysis showed elucidated treatment modality and complications as significant independent factors associated with DASH scores. This implies that treatment modality should be selected in rationalistic manner. Modalities like CRIF with TENS are recommended for a relatively younger population, otherwise complications can be envisaged which might end up in a higher disability.

CONCLUSION

The findings of the study showed that both the treatment modalities used in the present study achieved excellent or satisfactory outcomes with minimal complications with TENS having comparable outcomes in younger patients.

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