FUNCTIONAL OUTCOME OF SURGICAL TREATMENT OF DISLOCATED DISTAL METAPHYSEAL EPIPHYSEAL FOREARM FRACTURES

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Abstract

The purpose of this paper is to analyze and compare three surgical techniques (ORIF – open reduction, internal fixation, EF – external fixation and Kapandji) used in our department for distal forearm fractures, under the aspect of their functional outcome.

From 2009 to 2013 we followed and assessed, in terms of functional status, 120 patients who experienced a trauma which resulted in a fracture with displacement of the distal radius, with or without joint involvement (according to AO Classification) and received conservative treatment consisting of closed reduction of the fracture and immobilization in a cast and / or wrist immobilization brace, for a period of six weeks.

Functional evaluation was done posttraumatic (immediately after reduction and immobilization in a cast or brace), at 3, 7, 21 days, 6 weeks, 3 months, 6 months and one year, and took into account both objective assessment (ROM and tolerance to medium and large effort) and subjective (VAS scale).

Keywords: metaphyseal-epiphyseal region distal forearm fracture, conservative treatment, functional outcome

INTRODUCTION

Distal forearm fractures are very common type of fractures of the upper limb being a motive of controversy regarding their treatment. While non displaced fractures are treated mainly conservatively, the more complicated ones benefit from surgical treatment. (1.)

As surgical treatments are constantly evolving and developing, several new techniques have been brought to attention in the past decades.

It is important to identify the characteristics of the fracture and the fracture mechanism as well as the ones of the patient (age, associated pathology etc), in order to facilitate the optimal surgical treatment from the both internal and external fixation. (2)

As said before , in the past years, surgical treatment registered a significant development, choice of various techniques (ORIF, EF, KAPANDJI) being still open for debate and not achieving a consensus reach as to which one is the best The desired purpose in these treatments is the returning of the patient to his prior daily and work activity at the same level of function he had before.(3,4) So, general attention is attributed to the outcome of these treatments in the short and long term follow-up which

includes restoring as good as possible, the regional anatomy, reducing the rate of complications, as well as allowing early mobilization and returning to activity. (5)

Purpose

The functional outcome is regarded as a measure of efficacy of surgical treatment in these fractures, so the purpose of this paper is to analyze and compare three surgical techniques (ORIF – open reduction, internal fixation, EF – external fixation and Kapandji) used in our department for distal forearm fractures, under the aspect of their functional outcome.

MATERIAL AND METHODS

Our study is a prospective one during a period of 5 years followed by a retrospective analysis. In the study we included 98 patients who were surgically treated for distal forearm fractures (Fig.2) through the methods mentioned above. All the operations took place at Oradea Emergency County Hospital, Department of Traumatology and the operative techniques were as described in AO Surgery Reference (AO manual). (22) The cases were evaluated before, immediately after surgery and at a follow up period of 6 weeks, 3 months, 6 months and one year.

The evaluation criteria were objective and subjective ones. We assessed the functional outcome objectively through clinical exam as well as radiographic exam.

Clinical exam consisted in evaluation of ROM in the fractured arm compared with the healthy one. The normal values were 75^0 for flexion, 70^0 for extension, 20^0 for radial deviation, 35^0 for ulnar deviation, 85^0 for supination, 70^0 for pronation (Fig. 1, Table 1). (6)

Fig 1.: Normal range of motion for radio carpal joint (Image from htpp://www.revolutionarytennis.com/Resources/wristandhandterm.jpeg)

Radiographs were taken before and after the surgery and at the time of the follow up. We analysed the articular congruity, radial height, radial inclination and the volar tilt. The parameters used for assessing the

postoperative results were applied on radiographs as those illustrated in the figure 2. (7, 8)

The subjective parameters were assessed with DASH questionnaire and Gartland and Werley scoring system. DASH questionnaire includes 30 questions in order to assess every day activities performances, the pain, weakness and paresthesia. It goes from 0 which means no dysfunction to 100 which means severe dysfunction. (9)

Gartlend and Werley scoring system follows pain, wrist ROM and residual deformity and it is considered excellent if it's low, closed to 0 and poor if it's high, 19 or higher, as it follows 0-2 is considered excellent, 3-8 good result, 9-19 fair and 19 or higher is considered poor result. There are many scoring system to assess functional outcome but we chose these ones because they are the most widely used. (10, 11)

Last but not least we evaluated the complications which were recorded at the times of the follow up. The most frequent problems which appeared were carpal tunnel syndrome, tenosynovitis and/or tendon rupture, flexor and extensor tendon irritation, complex regional pain syndrome, loosening or displacement of the screws. The McKay score was used to classify the complications (12)

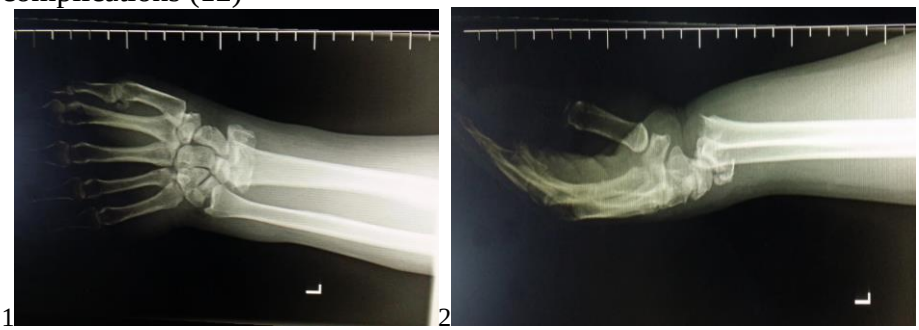


Fig.2: radiological aspect of distal radius fracture (1-AP and 2-LL view)

Fig.3: surgical techniques (1-closed reduction, external fixation; 2-Kapandji surgical technique; 3-open reduction, internal fixation)

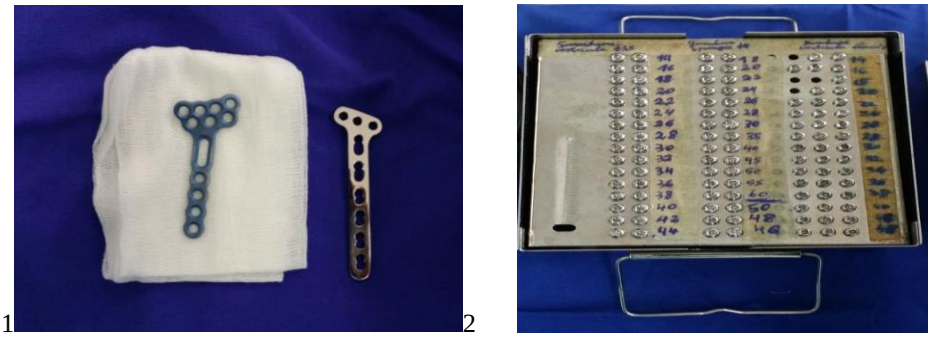


Fig.4: implants for open reduction, internal fixation (1-plates, 2-screws)

The statistical analysis has been done using ANOVA variation analysis, with Bonferroni or Tamhane correction, Post Hoc Test, Levene test, Pearson Chi Square test and t-Test.

The surgical approach has as main goal to preserve as much as possible the articular congruity, to reduce the incidence of radial shortening and mal union. The achievement of these goals is demonstrated to increase the outcome and the quality of life as well as to decrease the number of complications. (13, 14)

RESULTS AND DISCUSSIONS

Out of the 98 patients within our study 33 were men and 65 were women, with the mean age of 52 years (range 19-82) and the follow up period was 6 weeks, 3 months, 6 months and one year.

Distribution of fracture type according to AO classification is, 22% type A, 43%type B and 35% type C. (Fig 5)

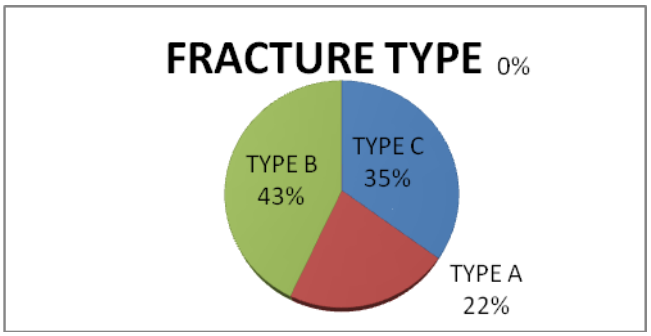


Fig.5: Distribution of fracture type according to AO classification

Regarding the surgical intervention, after a thorough analyse of the cases 35 were treated with ORIF, 5 with EF and 58 with Kapandji technique. (Fig.6)

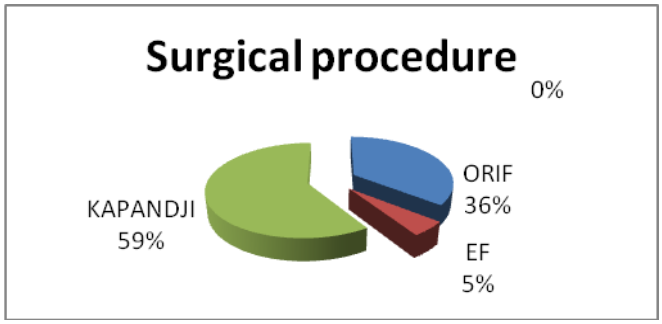


Fig.6: Distribution of surgical approach

Clinical assessment revealed that ROM in the patients treated with the three techniques was approximately the same with no significant differences as shown in the table below, (never the less we noticed a slight decrease in terms of the functional results following EF technique) after one year follow up (Table 2). We have used as reference measurements the opposite (healthy) wrist and the American Society for Surgery of the Hand indications as normal range of motion of the wrist and forearm (Table 1).

Table 1

Normal ROM values

		NORMAL RANGE OF MOTION
Forearm	Pronation/Supination	70°/85°
Wrist	Extension/Flexion	70°/75°
	Radial/Ulnar	20°/35°

Table 2

Mean value; percentage out of normal considered ROM values

	RANGE OF MOTION DATA		
Measurements	ORIF	EF	KAPANDJI
Wrist flexion	91.7%	83,2%	87,9%
Wrist extension	87,6%	79,2%	84,3%
Wrist pronation	93,2%	87.3%	94,3%
Wrist supination	90,1%	86,6%	92,1%

The radiographic parameters for all three surgical procedures as measured at time of the trauma (pre- and postoperatively) and at the follow up period are presented in table 3

Radial mean height improved from 0,4 cm preoperatively, to 0,9 cm postoperatively and reduced to 0,8 cm at 1 year follow-up in the case of ORIF technique. The mean radial inclination was $12,1^0$ pre op, changing to $19,2^0$ immediately postop. And reaching a final value of $18,7^0$ at the final follow up. Regarding volar tilt we registered initial pre operatory values at

the mean of -23, 4^0, $-1,1^0$ postop, with a final value of $-2,1^0$ at 1 year follow up. The radiographic parameters for the other two techniques are very close to the ones described in ORIF as presented in the table below.

Table 3

Before treatment, after treatment, at 6 weeks, at 6 months and at 1 year

	ORIF	EF	KAPANDJI
Radial height (cm)	0,4/0,9/0,8/0,8/0,8	0,4/1,1/1,0/0,8/0,8	0,6/0,9/0,8/0,7/0,7
Radial inclination (°)	12,1/19,2/18,7/18,7/18,7	9,7/20,1/20,1/19,8/19,1	10,2/19,8/18,4/17,8/17,1
Volar tilt (°)	-23,4/-1,1/-1,8/-2/-2,1	-24,7/-1,2/-1,4/-2,2/-2,9	-22,1/-1,1/-2,7/-7,7/-8,8

The mean DASH score at 1 year follow up was 8 in ORIF technique, 11 in EF and 16 in KAPANDJI , the values being quiet similar in the first two techniques with a lower score in case of Kapndji procedure.

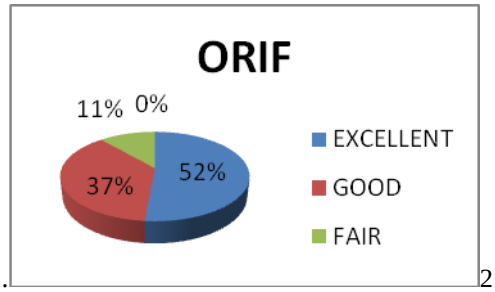
Table 4

DASH score at 1 year follow up

DASH Score			
	ORIF	**EF**	**KAPANDJI**
1year follow up	8	11	16

Regarding Gartland and Werley scale, out of the 35 patients treated with ORIF 18 scored excellent, 13 scored good and 4 scored fair. In the case of EF 3 patients registered a good score and 2 had fair results. Kapandji procedure had again a poorer outcome compared to the other two, from the total of 58 patients 20 scored excellent, 25 scored good, 11 scored fair and 2 scored poor. (Fig.7/1, 2, 3)

1.



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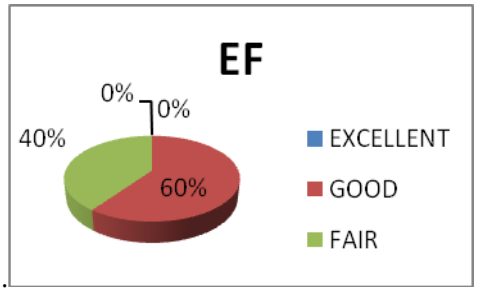

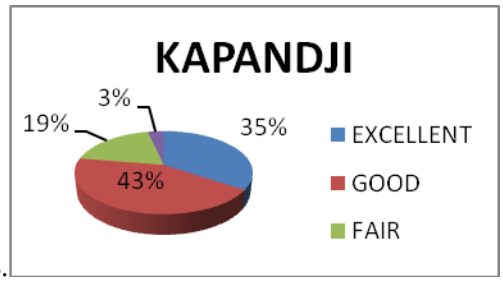

3.

Fig.7: The functional score outcome using Gartland and Werley scale for ORIF (1), EF (2) and KAPANDJI technique (3)

Complications:

Nineteen out of 98 patients registered complications after treatment, of whom 12 were in the Kapandji group.

Tendon related complications as tenosynovitis and tendon irritation affecting the extensor and flexor tendons was seen in 1 patient treated with ORIF and 3 patients treated with Kapandji technique.

Carpal tunnel syndrome was registered in a number of 7 patients treated with ORIF (3 patients) and Kapandji (4 patients) and complex regional pain syndrome in 2 of the cases, the last one encountered only after Kapandji procedure.

Mal union and delayed union was not a frequent problem involving only one case treated with EF

Complication due to metal material used were seen in 8 of the cases treated, most after Kapandji technique.

We concluded that the most frequent complications were carpal tunnel syndrome, complex regional pain syndrome and metal material complications and that the most complications were recorded after Kapandji technique (more than half of the total number of complications).

Table 5

The distribution of complication in relation with the technique used is shown in the table below

	TECHNIQUE		
Complications	**ORIF**	**EF**	**KAPANDJI**
Tenosynovitis	-	-	**1**
Tendon rupture	-	-	-
Tendon irritation	**1**	-	**2**
Carpal tunnel syndrome	**3**	-	**4**
Complex regional pain syndrome	-	-	**2**
Malunion/delayed union	-	**1**	-
Metal material complications	**1**	**1**	**3**

The results found in our study are comparable to other studies in literature, like M. Rizzo et all. (15) which established in their study that the outcome after the surgical treatment with ORIF technique is superior to the other two techniques under both the aspects of subjective parameters (DASH), as well as objective ones (radiographic measurements). N. Schmelzer et all. (16) also stated in their paper that ORIF registered better functional and radiological results and fewer complication compared to EF technique. Wicke et all (17) found no significant differences regarding DASH results in the surgical technique studied, but objective function (ROM, radiographic parameters) were slightly better in ORIF procedure.

On the other hand there are several studies like Karantana et all. (18), Rozental et all. (19), Grewal et all. (20), Wei et all. (21), which all showed that in the short term follow up Orif technique is better but at 1 year follow there were no significant differences between the surgical procedures.

CONCLUSIONS

The choice of surgical treatment in distal forearm fractures is made by taking into consideration the characteristics of the fracture as well as of the patient, with great concern regarding the returning of active patients to their prior level of performance.

Although statistically the ORIF technique has shown results slightly better compared to the other two, it is fair to say that all three surgical procedures we studied have quite similar results in the functional outcome at short and long term follow-up.

As surgical treatment is constantly changing and improving several new techniques become available, fact that gives us the strength to believe that the proper the treatment is chosen, the better results are expected.

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