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Outcome of Management of Distal Radius Fractures By Ligamentotaxis

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Abstract
Objectives : *A prospective study of management of fracture distal radius by external fixator using the principle of ligamentotaxis was conducted from August 2012 to October2014 at our institute to evaluate the clinical efficacy of external fixator with ligamentotaxis in distal radius fracture reduction, fracture healing, functional recovery after surgery.*
Material and Methods: *33 cases of fracture distal radius were treated with ligamentotaxis. Inclusion criteria were 1) skeletally mature individuals. 2) Patient who gave consent for this procedure.3)Closed unstable extra articular fractures. 3) Communited fractures. 4)Intra articular fractures. 5) Polytrauma with distal radius fractures. Fracture was anantomically reduced and fixed with external fixator with ligamentotaxis. Patients were evaluated based on Modified Demerit point system of Gartland and Werley.*
Results: *With external fixation and ligamentotaxis, the result in majority of cases was excellent to good. Hence this study conclude that external fixator with ligamentotaxis is a good method of treatment in fracture distal end of radius.*
Keywords – *distal radius, external fixator, fracture, ligamentotaxis*

I. Introduction

Distal radius fractures represent approximately one-sixth of all fractures treated in emergency departments. There seems to be a growing incidence of these fractures in all age groups with the sharpest increase seen in both elderly females and younger adult males [1,,2,3]. Current data suggest that distal radius fractures in the elderly may represent an insufficiency fracture associated with all of the risk factors for osteoporosis[4]. In 1814, **Abraham Colles,** Prof of anatomy and surgery of Trinity college of Dublin clearly defined the fracture and outlined the treatment modality, and devised plaster of paris cast still commonly used called "Colle's cast". He stated that "fracture takes place about an inch and half above the extremity of radius. In 1977, external fixator method gained popularity among orthopaedicians with **Vidal** Jacques described original method of treatment of these fractures with **ligamentotaxis**.[5]Since their description by Colles in 1814, distal radial fractures remain a therapeutic challenge[6]. A prospective study of management of fracture distal radius by external fixator using the principle of ligamentotaxis was conducted to evaluate for the clinical efficacy of external fixator with ligamentotaxis in distal radius fracture reduction, fracture healing, functional recovery after surgery.

II. Material And Methods

A total number of 33 cases of distal end radius fracture treated by ligamentotaxis were studied from August 2012 to October 2014 admitted in ALLURI SITA RAMARAJU ACADEMY OF MEDICAL SCIENCES, ELURU, A.P., INDIA. Inclusion criteria were 1) skeletally mature individuals. 2) Patient who gave consent for this procedure.3)Closed unstable extra articular fractures. 3) Communited fractures. 4)Intra articular fractures. 5) Polytrauma with distal radius fractures.

All fractures were classified according to **Frykman's classification (Type I to VIII)** and instability was judged by Cooney's criteria (only in Frykman's type 1 and 2.) Baseline demographics and injury characteristics were recorded. In this study of 33 patients, 11(33.3%) sustained type VIII fracture, 7(21.2%) had type VII fracture, 5(15.1%) had type VI fracture, 3(9.1%) had type type I fracture, 2(6.1%) each sustained type III, IV, V fractures, one(3%) had type II fracture. In the present study, 33 cases which represent 80% of total cases we have done, (rest lost in follow up) which were followed up for average of 10 months; 76% i.e. 25 were male and 24% i.e 8 were females. The right wrist was involved in 58% i.e. 19 of our cases and left 42% of our cases. The dominant hand in 65% of cases. The patients in young working age group 20-40yrs were 24 cases representing 74% of our cases. The number of cases in complex intraarticular fractures i.e. Frykman type VII and VIII represented 58% of our cases and constituted 52% of cases among 20-40 yrs. Number of cases due to road traffic accident constituted 60% and fall on outstretched hand constituted 40% of our cases. Associated

injuries constituted 40% of our cases. These results of all patients were evaluated as per the criteria suggested by Gartland and Werley (Functional)[7] [Table 1 & 2]

Table - 1 Modified Demerit Point System Of Gartland And Werley	
Category	***Points***
Residual deformity (0-3 Points)	
Prominent ulnar styloid process	1
Residual dorsal tilt.	2
Residual deviation of hand	2-3
Subjective evaluation (0-6 points)	
Excellent: No pain, disability or limitation of motion	0
Good: Occasional pain, some limitation of motion and no disability	2
Fair: Occasional pain, some limitation of motion, weakness in wrist, activities slightly restricted.	4
Poor: Pain limitation of motion, disability, Activities more or less markedly restricted.	6
Objective evaluation (0-5 points)	
Loss of dorsiflexion	5
Loss of ulnardeviation	3
Loss of supination	2
Loss of Palmarflexion	1
Loss of radial deviation	1
Loss of circumduction	1
Pain in distal radioulnar joint	1
Grip strength 60% or less than opposite side	1
Loss of pronation	2
Arthritic changes	
Minimum	1
Minimum with pain	3
Moderate	2
Moderate with pain	4
Severe	3
Severe with pain	5
Nerve complications (Median)	1-3
Poor finger functions due to cast	1-2

Table - 2 Grading

EXCELLENT	0-2
GOOD	3-8
FAIR	9- 20
POOR	>21

1.1. Operative procedure

All surgeries were performed within 24 to 48 hours of admission. In all cases, the fixator was applied before fracture manipulation in a trans-articular fashion. Once reduction was achieved, K-wires were used as adjuvant fixation for stabilization. On achieving the desired reduction the wrist was locked and placed in a functional position. Finally, under the image intensifier, the minimum required distraction was applied across the wrist. Distal radioulnar joint instability was assessed and corrected by reducing and transfixing with K-wires from distal ulna to distal radius. Most of the cases were treated with external fixator on the day of injury within 8hrs of injury. The fixator was removed after 6 wks followed by hot paraffin wax bath treatment and active physiotherapy. The follow up period averaged 9 months the highest being 18 months and the least being 3 months.

1.2. Results

This study achieved excellent results in 23(69.7%) patients, good in 6(18.1%) patients, fair in 2(6.1%) patients, poor in 2(6.1%) patients evaluated as per the criteria suggested by Gartland and Werley (Functional). [43T] (fig1)In this study, 18.2% (6) had wrist pain and stiffness and 18.2% (6) had finger stiffness as their post operative complication. Out of 14 patients with wrist pain, 7 patients had pain due to prominent ulnar styloid secondary to malunion or DRUJ instability. Wrist pain and stiffness and finger stiffness significantly improved after physiotherapy.




fig 1 **fig 2** **fig 3** **fig 4**

Fig- 1: pre-operative radiograph showing Type III Frykman's classification. fig 2: post operative radiograph with external fixator insitu. fig 3 & 4 : follow up radiograph after 12 months.




fig 5 **fig 6** **fig 7** **fig 8**

Fig – 5 to 8 : functional range of wrist movements at 12 months follow up

Our case series attributes to 88% of excellent to good results and 12% of fair to poor results. Thus, it suggests that ligamentotaxis plays a good role in anatomic restoration in unstable fractures as well as intra articular fractures.

III. Discussion

The fracture of distal end radius is the most common fracture we treat. Management of fracture distal end of radius is still a challenge for orthopaedic surgeon and pose therapeutic problem in term of reduction of fracture, maintenance of reduction till the fracture unites, mobility of the joint after fracture union. Failure in the management may cause permanent disability[8]. But the outcome of these fractures is not uniformly good regardless of treatment instituted. We agree with **GREEN** that a good functional result usually accompanies a good anatomical reduction.[9] The small A.O external fixator provides a simple and reliable means of treating distal end radial fractures especially unstable intraarticular fractures employing the concept of ligamentotaxis that was proposed by Vidal et al. [10] The efficacy of ligamentotaxis in neutralizing detrimental compression forces, which are likely to cause displacement of unstable fracture with radial shortening, is a significant and increasingly appealing advance in the management of distal radius fracture. [11]

Biomechanical studies by Nakata et al showed the resistance of A.O devices to axial loading to be greater than that of most other fixators. [12]

In 1961, **Dowling and Sawyer** evaluated results of percutaneus pinning fixation in 51 patients with 84% excellent to good results.[13] In 1979, **Cooney et al** published results of 60 patients treated with R.A Frame with 87% excellent to good results.[14] In 1984, **D'Anca et al** evaluated results of Hoffman fixation in 54 patients with 94% excellent to good results.[15] In 1984, **Schuind et al** evaluated results of Hoffman fixation in 63 patients with 94% excellent to good results. [16] In 1985, **Vaughan et al** published results of 52 patients treated with R.A Frame with 94% excellent to good results.[17] In 1987, **Jenkins et al** published results of 72 patients treated with A O Fixator with 93% excellent to good results. [18] In 1989, **Howard** evaluated results of Hoffman fixation in 50 patients with 96% excellent to good results. In 1991, **Jakim et al** evaluated results of Hoffman fixation in 132 patients with 83% excellent to good results.[19] In 1991, **Edwards** published results of A O fixation in 30 patients with 96% excellent to good results.[20] In 2000 **Kapoor H Aggarwal** concluded from their studies in 90 cases of unstable distal radius fractures that results were good or excellent in 80% of external fixator. In April 2001, **Markowitz AD** published a paper on five pin external fixator and early mobilization. They emphasized to use on dorsal pin (additional) incorporated in external fixator to correct dorsal tilt found in many fractures of distal end radius. Additional pins would help to reduce those fragments that would not improve with traction alone, thus unnecessary excessive traction is avoided.[21] In 2010, **Aktekin et al.** found

that wrist extension, ulnar deviation, palmar tilt and radial height were better in those treated with external fixation.[22] In 2012, **Wei et al.** reported good results with external fixation when satisfactory reduction is obtained.[23] In 2013, **Rajeev shukla et al** concluded from their studies in 72 cases of intraarticular distal radius fractures that Joshi's External Stabilizing System is a cost effective technique and a good option in displaced distal end radial fractures.[24] In 2014, **Deepak CD, Gopalakrishna G, Ravoof A et. al.** assessed the results of 20 patients of unstable distal radius fractures with / without intra-articular extension and concluded that external fixation and ligamentotaxis provides better functional and anatomical results in comminuted intra-articular and unstable extra-articular wrist injuries.[25] **Our case series** attributes to 88% of excellent to good results and 12% of fair to poor results.[Table – 3]

Table – 3 Functional Results Of Various Case Series

S.NO	Name of Series	Modality of treatment	Number of cases	Results (Functional)	
				E/G	F/P
1.	Rajeev shukla (2013) [24]	JESS	72	77.8%	22.2%
2.	GS Edwards (1991)[20]	A.O	30	96%	4%
3.	I. Jakim et al (1991)[19]	Hoffmann	132	83%	17%
4.	Howard 1989	Hoffmann	50	96%	4%
5.	Jenkins et al (1987)[18]	A.O	72	93%	7%
6.	Vaughan et al (1985)[17]	R.A Frame	52	94%	6%
7.	Schuind et al (1984)[16]	Hoffmann	63	94%	06%
8.	D'Anca et al (1984)[15]	Hoffmann	54	94%	06%
9.	Cooney et al (1979)[14]	R.A Frame	60	87%	13%
10.	Cole and Obletz (1966) [7]	Pins and Plaster	33	94%	6%
11.	Dowling and sawyer (1961)[13]	Percutaneous Pinning	51	84%	16%
12.	**Our series**(Present study)	**A.O**	**33**	**88%**	**12%**

IV. Conclusion

The following conclusions can be made from our series. 1) The distinct advantage of external fixator are its superior mechanical efficiency, its capacity for fracture adjustment during healing period. 2) The small A.O external fixator is a simple device and easy and safe to use even under regional anesthesia. 3) The shorter period of surgery, minimal exposure , no need for tourniquet are its distinct advantage over plate fixation.4) Can be performed in emergency with minimum instrumentation and expertise i.e. even by a trainee. 5) The use of external fixator is an effective method of treating unstable extraarticular and complex intraarticular fractures of the distal end radius.

Finally we would like to conclude that External fixator is an easy, cost effective, reliable and most suitable treatment in treating intraarticular and unstable extraarticular distal end radial fractures by the "Principle of ligamentotaxis".

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