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## ORIGINAL ARTICLE

# RESULTS OF LIGAMENTOTAXIS TECHNIQUE IN TREATMENT OF INTRA-ARTICULAR DISTAL RADIUS FRACTURE

Adel Mohamed Salama<sup>1</sup>, Amr Mohamed Ahmed El-Adawy<sup>1</sup>, Ahmed Mashhour<sup>1</sup>, Makhzum Ramadan Bentaher<sup>3\*</sup>.

Orthopedic Surgery department, Faculty of medicine, Zagazig University, Zagazig, Egypt

### \*CORRESPONDING

#### AUTHOR:

Name: Makhzum Ramadan

Bentaher,

Email:

[makhzoum.bentaher@gmail.com](mailto:makhzoum.bentaher@gmail.com)

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### ABSTRACT:

**Background:** Intra-articular distal radius fractures are unstable, difficult to reduce it anatomically and to immobilize in closed cast and are associated with high rate of complications. External fixation is accepted generally as superior to closed plaster in young patients with intra-articular comminuted displaced distal radius fracture.

The **study Aims to** evaluate the radiological and functional outcome of intra-articular distal radius fractures treated by external fixator using ligamentotaxis.

**Methods:** A prospective analysis of 12 patients with Intra-articular distal radius fracture. The right side was affected in 5 patient and left side 7 patients, all of patient treated by external fixator. The patients were assessed clinically by Sarmiento modification of Gartland and Werley score post-operatively.

**Results:** Functional evaluation was performed according to the criteria described by modification with Sarmiento of Gartland and Werley score. Results were excellent in 6 (50%), good in 4 (33.3%), and fair in 3 (16.7%) patients. No patient had poor result.

**Conclusions:** External fixator yields excellent radiological and functional results in majority of comminuted intra-articular distal radius fractures. And it is a stable fixation which permits movements of fingers, elbow and shoulder and is safe & simple procedure acceptable by the patient.

**Keywords:** Intra-articular ; Comminuted; Distal radius; External fixator; Ligamentotaxis



### INTRODUCTION:

Distal radius fractures continue to be the most common skeletal injuries treated by an orthopedic surgeon. In fact, these injuries are the most common fractures of the upper limbs injury and account for approximately 1/6th (16%) of all fractures seen and treated in emergency operation room [1]. Many fractures of the distal radius are uncomplicated and are effectively treated by closed reduction and immobilization in plaster of Paris (cast). Unstable/intra articular fractures can affect the integrity of the articular congruence and/or kinematics of these articulations [2]. Intra-articular fractures are unstable, difficult to reduce anatomically and to immobilize in closed cast support and are associated with high rate of complications [3]. Distal radius fractures disturb the mechanical foundation of the human's most elegant tool, the hand. The same ligaments, retinaculae, tendons, and periosteum that envelop the fracture which are the surgical barriers for open reduction of the fracture fragments, help achieve reduction of the fracture by Ligamentotaxis [4]. The articular surface of the distal end of the

radius tilts 6 to 11 degrees in the lateral plane and 22 degrees in the antero-posterior plane. The dorsal cortical surface of radius thickens forming the Lister tubercle as well as two osseous prominences supporting the extensors of the wrist in 2nd extensor compartment. A central ridge divides the articular surface of the distal radius into a lunate facet and a scaphoid facet. The triangular fibrocartilage (TFCC) extends from the rim of the sigmoid notch of the radius to the styloid process of the ulna. The brachioradialis tendon is the only tendon inserted onto the distal radius; the other tendons of the wrist insert onto the carpal bones or the bases of the metacarpals after passing across surface of the distal aspect of the radius[5]. Preservation of the articular surface congruity is the principle prerequisite for successful recovery [6]. External fixation is accepted as superior to plaster immobilization in patients with intra-articular comminuted displaced distal radius fracture [7].

### METHODS:

**Study design and settings:** A prospective and retrospective analysis of 12 patients with intra-

articular fracture of distal radius. The right side was affected in 5 cases, the left in 7 cases treated by ligamentotaxis technique by external fixator was conducted between September 2018 and April 2019 in Orthopedics and Traumatology Department, Faculty of Medicine, Zagazig University Hospital and Zliten teaching hospital. Written informed consent was obtained from all participants and the study was approved by the research ethical committee of Faculty of Medicine, Zagazig University. The work has been carried out in accordance with The code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. **Inclusion criteria:** Patient aged 18 years and above with intra-articular and Comminuted distal radius fracture type B and C according to AO classification and open fractures of distal radius. **Exclusion criteria:** Patients below the age of 18 years and patients whose are unfit for surgery. **Methods:** On admission all patients were subjected to history taking, clinical examination and laboratory investigations. Full counseling of participants in this research and informed consent was obtained with full privacy of participants and confidentiality of the data. **History Taking, Personal history:** Name, Age, Sex, Residency and occupation. **Assessment:** Radiological assessment by anteroposterior (AP) and lateral (Lat) of wrist X-ray was taken pre-operatively, immediate post-operative period and at follow-up. And assessment of functional at end of follow-up according to modification by Sarmiento of Gartland & Werley functional scoring system of the wrist, End result point range: (Excellent 0-2, Good 3-8, Fair 9-20, Poor  $\geq 21$ ). **Surgical Technique:** Under general anesthesia, The sites of proximal fixator pin are exposed with a small incision made via open technique on the dorsal aspect of the radial shaft. It is important to identify the superficial branch of the radial nerve and soft tissue and protect it and released before pin insertion.. The pins are placed in the radial shaft after predrilling and using drill sleeve as a soft-tissue protector. The pins are hand driven into the far cortex of the radius and their position is confirmed with fluoroscopy. Application of distal schanz: skin incision is made over base of 2nd metacarpal posterolateral, dissection is carried down to reach bone, insertion of two 3mm schanz posterolateral at its metaphyseal flare to go into the base of the third metacarpal bone but not beyond this point. Tighten the clamps to the distal and proximal schanz, tighten the rod of one clamp allowing the other side of the rod to move freely in the clamp, allow traction on distal segment (such that intercarpal distance equal radiocarpal distance guided by fluoroscopy, to avoid over distraction

and joint stiffness at fixator removal) while assistant tighten the other clamp to maintain this position. **Radiological evaluation** of Radial inclination, Volar tilt, Radial length. **Post-operative:** Immediate post operatively the patients were examined for neurovascular status. They were also instructed to do forearm and hand elevation, full range of fingers movement as well as the elbow and shoulder. They were also instructed how to do pin site care to avoid pin tract infection. Mild disinfectants and sterile saline were used for pin site care. Colored disinfectants were avoided, since the skin would be stained and inflammation might be obscured.

#### STATISTICAL ANALYSIS:

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) (Statistical Package for the Social Sciences) software for analysis. P value was set at  $<0.05$  for significant results &  $<0.001$  for high significant result.

#### RESULTS:

The age of the studied patients ranged from 29 to 60 years old with mean age 41.83 years old. The average time for follow-up was 6 months, ranging from (5 to 7) months. The right side was affected in 5 cases and the left in 7 cases, and 8 patients were males 66.7% while 4 were female 33.3%, and 75% had 6 weeks for union time and 25% took 8 weeks of union, and 83.3% were closed fracture and 16.7% were open fracture. The 12 patients of the study 6 cases (50%) had excellent result, 4 patients (33.3%) had good results, 2 patients (16.7%) had fair results according to modification by Sarmiento of Gartland and Werley score [8]. **(Table 1) (Figure 1).** During the follow up of the wrist joint range of motion, the wrist flexion movement ranged from 45 degrees to 80 degrees with the average was 67.5 degrees. The wrist extension movement ranged from 40 degrees to 75 degrees with average was 62.5 degrees. The radial deviation movement ranged from 5 to 30 degrees with the average was 17.5 degrees. The ulnar deviation ranged from 20 to 40 degrees with the average was 37.5 degrees. The supination movement ranged from 40 degrees to 80 degrees with the average was 60 degrees and the pronation movement ranged from 55 degrees to 85 degrees with the average was 75 degrees, and grip strength post operative ranged from 50 to 90 % with average 69.5% from the contralateral normal side measured by Dynamometer **(Table 2).** In this study there were 8% Sudeck's atrophy and 25% had superficial infection, 8% had sensory nerve affection **(Table 3).** Relation between outcome and complications

can be summarized as following ;There was significant correlation between age and final clinical results. P.value 0.024 (statistically significant). (Table 4) and also significant correlation between union time and final clinical

results with P. value 0.007 (statistically significant) as well as significant correlation between type of fracture according to AO and final clinical results. P. value 0.002 (statistically significant).

**Table 1:** Distribution of age and sex and side of trauma and final score :

		Age	
<b>Mean± SD</b>		<b>41.83±10.3</b>	
<b>Median (Range)</b>		<b>39.5 (29-60)</b>	
		<b>N</b>	<b>%</b>
<b>Sex</b>	<b>Female</b>	<b>4</b>	<b>33.3</b>
	<b>Male</b>	<b>8</b>	<b>66.7</b>
<b>Side</b>	<b>Left</b>	<b>7</b>	<b>58.3</b>
	<b>Right</b>	<b>5</b>	<b>41.7</b>
<b>Total Sarmiento</b>	<b>Excellent</b>	<b>6</b>	<b>50.0</b>
	<b>Good</b>	<b>4</b>	<b>33.3</b>
	<b>Fair</b>	<b>2</b>	<b>16.7</b>
	<b>Total</b>	<b>12</b>	<b>100.0</b>

**Table 2:** The Grip strength and range of motion post-operative

	<b>Dorsiflexio n</b>	<b>Palmar flexion</b>	<b>Supination</b>	<b>Pronation</b>	<b>Ulnar deviation</b>	<b>Radial deviation</b>	<b>Grip strength</b>
<b>Mean± SD</b>	58.33±11.9	66.66±11.93	61.66±16.28	74.16±9.49	33.33±8.07	17.91±6.89	<b>69.58±11.9</b>
<b>Median (Range )</b>	62.5 (40-75)	67.5 (45-80)	60.0 (40-80)	75.0 (55-85)	37.5 (20-40)	17.5 (5-30)	<b>67.5 (50-90)</b>

**Table 3:** Complication distribution in the study:

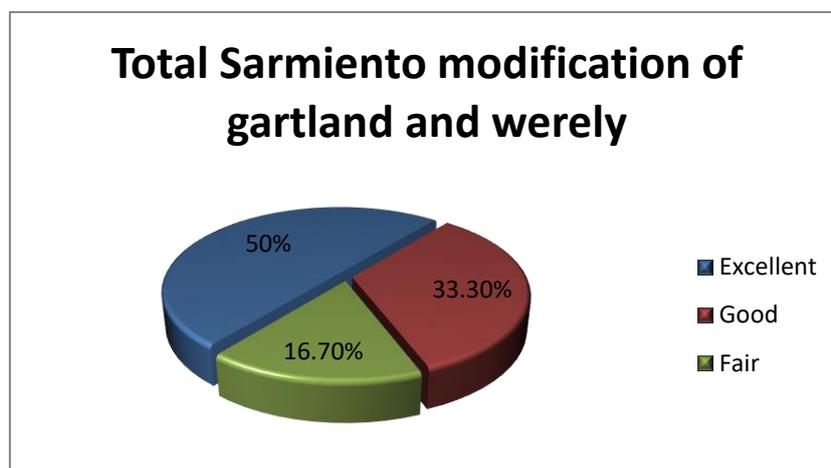
	Complications		Frequency	
	No.	%	No.	%
<b>Sudeck's atrophy</b>	1	8		
<b>Pin tract infection</b>	3	25		
<b>Superficial radial nerve affection</b>	1	8		

**Table 4:** Association and relation with outcome:

	Group	t/ X2		P
		Poor outcome	Good outcome	
<b>Age</b>	Mean ±SD	56.41±1.75	39.0±8.74	-2.651 0.024*

			Group		t/ X2	P
			Poor outcome	Good outcome		
<b>Union time</b>	6.00	N	0	9	7.2	0.007*
		%	0.0%	90.0%		
	8.00	N	2	1		
		%	100.0%	10.0%		
<b>AO classification</b>	C1	N	0	3	11.87	0.002*
		%	0.0%	30.0%		
	C2	N	0	7		
		%	0.0%	70.0%		
	C3	N	2	0		
		%	100.0%	0.0%		
<b>Union time</b>	6.00	N	0	9	7.2	0.007*
		%	0.0%	90.0%		
	8.00	N	2	1		
		%	100.0%	10.0%		
<b>Total</b>		N	2	10		
		%	100.0%	100.0%		

Good outcome cases younger in age, also significantly shorter regard union time, also good outcome associated with C1 & C2 AO classification and bad with C3



**Figure 1 : Results according to Sarmiento modification of Gartland and Werley system.**  
**Results according to Gartland and Werley system.**

**DISCUSSION:**

Intra-articular distal end of radius fractures with multiple fragments are mostly hard to reduce and stabilize due to unstable characteristics [9]. The primary goal in treatment of intra-articular distal radius fractures is to achieve optimal restoration of the disrupted anatomy, and quick return of the hand

function. If these goals are achieved, better final functional result will be expected[10]. External fixation with principle of ligamentotaxis for reduction of the fragments has gained wide acceptance for the treatment of unstable intra-articular fractures of the distal radius[11]. In these series twelve patients, twelve cases of intra-

articular distal radius fracture were treated by ligamentotaxis technique by external fixators and followed up. Ten of patients was closed fractures and two of patients was open fracture. The affected patients' age ranged from 29 to 66 years old with mean of (41.83±10.30). There were 8 males and 4 females. the most common mode of trauma in this study was falling on out-stretched hand (41.7%) and falling from height (33.3%) and road traffic accident (25%). Average follow up period was six months, the longer period of follow up allows good rehabilitation and better function of the hand and fingers. At the end of the follow up period, according to modification by Sarmiento of the Gartland and Werely scoring system, 6 patients (50%) had excellent results, and 4 patients (33.3%) had good results and 2 patients (16.7%) had fair results, no patients had poor results. In a study made by **Adnan Kara and Erden Ertürer et al**[12]. Treated 35 of distal radius fractures with static external fixator and documented that ligamentotaxis consistently results in a favorable outcome in the management of unstable distal end of radius fracture. They achieved 88% good and excellent and fair in 12% results According to the clinical scoring system of Gartland–Werley and modified by Sarmiento. **Mondeep Gayan 1 , Mukheswar Pame ,et al**[13]. Treated of 15 patients with unstable fractures of the distal radius were treated by external fixator. There were excellent in 80% (12) cases, good in 13.33% (2) cases, fair in 6.66%. **Kapoor and Agarwal**[14]. In the final functional assessment (Sarmiento) the results with external fixator 80% good and excellent, 20% fair and poor results. They recommend that displaced severely comminuted intra-articular fractures should be treated with an external fixator. The wrist flexion movement range 45 - 80 degrees with the average was 67.5 degrees. The wrist extension movement range 40-75 degrees with average was 62.5 degrees. The radial deviation movement range 5-30 degrees with the average was 17.5 degrees. The ulnar deviation range 20-40 degrees with the average was 37.5 degrees. The supination movement range 40-80 degrees with the average was 60 degrees and the pronation movement range 55-85 degrees with the average was 75 degrees. Grip strength post-operative ranged from 50 to 90 % with average 69.5% from the contralateral normal side measured by dynamometer. In this work there were a positive correlation between the clinical final score and the patient age, the older the patient the worse the result, this was statistically significant. This may be explained by the increased prevalence of osteoporosis in older patients that makes the chance screw grip to be less firm, and younger patients had healthy articular surface before injury

and cooperative during rehabilitation. In spite of this there is a good outcome case significantly younger in age .and there is significant correlation between the union time and the functional at end of follow up which gives good outcomes in shorter union time. Our study had various limitations as various other methods for treating distal radius fractures were not compared with the external fixation method. Also the follow up was short and long term randomized comparative studies are needed to document the efficacy of this method of fixation.

#### CONCLUSION:

External fixator yields excellent radiological and functional results in majority of intra-articular distal radius fractures, and it is a stable fixation which permits movements of fingers, elbow and shoulder and is safe & simple procedure acceptable by the patient. **Conflict of interest: None**

**Financial disclosures: None**

#### REFERENCES:

1. Vishwanath C, Harish K, Gunnaiah KG, Ravooof A. Surgical outcome of distal end radius fractures by ligamentotaxis. *J Orthop Alli Sci* 2017;5(2):68.
2. Tahir T, Manzoor QW, Bhat SA, Kangoo KA. Functional outcome of external fixators in unstable distal radius fractures. *Int J Orthop Sci* 2018; 4(2.7):869–74.
3. Simic PM, Weiland AJ. Fractures of the distal aspect of the radius: changes in treatment over the past two decades. *JBJS*. 2003;85(3):552–64.
4. Shehovych A, Salar O, Meyer CER, Ford DJ. Adult distal radius fractures classification systems: essential clinical knowledge or abstract memory testing?. *Ann R Coll Surg Engl* 2016; 98(8):525–31.
5. Ipaktchi K, Livermore M, Lyons C, Banegas R. Current concepts in the treatment of distal radial fractures. *Orthop* 2013; 36(10):778–84.
6. Melone CP Jr. Distal radius fractures. Patterns of articular fragmentation. *Orthop Clin North Am* 1993; 24 (2): 239-53.
7. Ma C, Deng Q, Pu H, Cheng X, Kan Y, Yang J, Yusufu A, Cao L. External fixation is more suitable for intra-articular fractures of the distal radius in elderly patients. *Bone Res* 2016;4:16-17.
8. Sarmiento A, Zagorski JB, Sinclair WF. Functional bracing of Colles' fractures: a prospective study of immobilization in supination vs. pronation. *Clin Orthop Relat Res* 1980; (146):175–83.
9. Castaing J. Les fractures récentes de l'extrémité inférieure du radius chez l'adulte. *Rev Chir Orthop* 1964; 50(50):581–696.
10. Campbell, Douglas A., and Louise A. Crawford. "Fractures of the Distal Radius and Distal Radioulnar Joint." *Disorders of the Hand*. Springer Eng 2015.; pp259-84.
11. Alam W, Shah FA, Qureshi KM, Rehman SU, Hussain S, Imran M. Intra-Articular Fractures Of Distal Radius. *Professional Med J*. 2014.;21(04):649–653.
12. Kara A, Ertürer E, Seçkin F, Akman Ş, Öztürk İ.

- The treatment method and results of percutaneous pinning and dynamic external fixator application for unstable distal radius fractures. *Med Bull Sisli Etfal Hosp* 2018; 52(3), 173-78.
13. Gayan M, Pame M, Tahbieldar P, Bhattacharyya T, Dutta N. Early results of unstable distal radius fractures-orif with locking compression plate versus ligamentotaxis with external fixators. *J Evid Based Med Healthc* 2017; 4(34).
  14. Kapoor H, Agarwal A, Dhaon BK. Displaced intra-articular fractures of distal radius: a comparative evaluation of results following closed reduction, external fixation and open reduction with internal fixation. *Injury* 2000;31(2):75–79.

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