

## A Comparative Study of Functional Outcome of Extra Articular Distal End Radius Fracture Treated with Percutaneous Pinning Versus Volar Plating in a Sample of Egyptian Population

MOHAMED KAMAL, M.D.; SHERIF FATHY, M.D.; AHMED EL-NAGAR, M.Sc. and MAHMOUD MASSOUD, M.D.

*The Department of Orthopedic Surgery, Armed Forces Collage of Medicine*

### Abstract

**Background:** Distal end radius fractures are the commonest upper limb fractures that account for 17% of all upper extremity injuries. There is an increasing trend for volar plating rather than K wire fixation, which remained for long the golden standard fixation technique for such injuries.

**Aim of Study:** To compare the clinical, functional and radiological outcome of volar plating versus K-wire fixation for extra articular dorsally displaced distal end radial fractures.

**Material and Methods:** A randomized, prospective comparative study was carried out on 50 patients diagnosed as Coll's fracture; they were divided into two groups. The first group treated with percutaneous K wires and second group was treated with volar plating. The duration of follow-up was one year by X-rays and patient rated wrist evaluation (PRWE).

**Results:** Significant improvement of the range of motion, radiological union and PRWE score in the first 3 months in the plate group but there were no significant difference at the end of the first year.

No statistical difference of significant importance was noted regarding the complications rate.

**Conclusion:** Percutaneous pinning is safe, cheap and easy technique to maintain reduction in displaced, extra-articular distal radial fractures, with minimal complications.

**Key Words:** Volar plating – PRWE – Pinning – Wires – Radius.

### Introduction

**DISTAL** radial fractures represent about 10% to 20% of all the fractures come to emergency [1,2]. It has a bimodal age distribution, high energy trauma required in younger individuals while in elderly patients low energy trauma is required. Falling on

outstretched hand (FOOSH) works, car accident or sports related injuries are the most common mechanism [3]. The treatment options have been evolved over the past two decades from cast immobilization, percutaneous pinning and finally internal fixation with various types of plating.

Surgical fixation of the distal end radius fractures have led to tremendous improvement in functional outcome, and less disfigurement of wrist [4].

The optimal management of distal radius fractures remains controversial. For extra articular fracture of the distal end radius there is an increasing trend for volar plating rather than K wire fixation, which remained for long the golden standard fixation technique for such injuries [5]. The aim of our study was comparing the functional outcome of volar plating and K-wire fixation as regard extra articular dorsally displaced distal end radial fractures using Patient Rated Wrist Evaluation (PRWE) score for one year postoperative.

### Material and Methods

This was a prospective study that held on 50 adult patients diagnosed to have coll's fracture recruited from Helmeya Military Hospital in the period from December 2021 to June 2023 to compare the clinical, functional and radiological outcomes of volar plating versus K-wire fixation. They were divided into two groups, each of 25 patients. (Group A) was treated by open reduction and volar plating, while (Group B) was treated by closed reduction, percutaneous K-wire pinning.

#### *Inclusion criteria:*

- 1- Participants in the study were 18 years old or older.
- 2- Distal radius fracture within 3cm of the radio carpal joint.

---

**Correspondence to:** Dr. Mohamed Kamal, The Department of Orthopedic Surgery, Armed Forces Collage of Medicine

3- A2, 3 and B2, 3 fractures as classified by AO Classification system.

*Exclusion criteria:*

- 1- Skeletally immature patients.
- 2- Intra articular fractures.
- 3- Patients with open Gustilo type 2.
- 4- If patients are unfit for surgery.
- 5- Patients with pathological fractures.

Patients were recruited from both the emergency department and outpatient clinic for those suspected of wrist injuries. They were subjected to full history, clinical examination and radiological assessment was done by X-ray both lateral and posteroanterior (PA) views to assess the radial length, radial inclination, articular step-off and gap. While the palmar tilt was evaluated on the lateral view. Fractures were classified according to Association of the Study of Internal Fixation (AO) classification. The study was approved by the Armed Forces Collage of Medicine ethical committee in accordance of Helsinki. Written informed consent was obtained from all the patients. Patients were operated under general anesthesia, in Group A open reduction through Henery approach and internal fixation with conventional volar T-plate. Intra-operative C-arm was used to check the reduction and the position of the plate. Two weeks of immobilization by below elbow slab followed by early active range of motion (ROM) exercises. While in group B all patients were treated by closed reduction under C-arm guidance followed by percutaneous pinning by (1.6-2mm) smooth k-wires, below elbow slab to protect the k-wires for a period of 6 weeks after which the k-wires were removed in outpatients clinic and active ROM was initiated.

Postoperatively, oral antibiotics were prescribed for 10 days. In group A sutures were removed on the 15<sup>th</sup> post-operative day.

Patients were followed-up on 1, 3, 6, 12 months postoperatively. Follow-up included local examination of the wounds & its care, clinical as well as radiological examination.

*Patients were assessed by:*

- PRWE
- Functionally for ROM
- Radiological evidence of union, alignment & collapse.

*Statistical analysis:* Were performed using SPSS 16.0 statistical software (SPSS Inc., Chicago, IL, USA).

The radiological and clinical values were expressed as Means  $\pm$  Standard deviations. A  $p$ -value  $<0.05$  was considered statistically significant and that  $p < 0.001$  was considered highly significant.



Fig. (1): Postoperative AP and lateral views of DER fracture.



Fig. (2): Postoperative AP and lateral views of DER fracture.

## Results

Mean age of included subjects in plate group was  $43.4 \pm 15.67$  years and in k-wire group was  $43.24 \pm 15.79$  years with no significant difference between the two groups ( $p=0.9715$ ).

In plate group males were 18 (72%) cases and females were 7 (28%) cases, in k-wire group males were 12 (48%) cases and females were 13 (52%) cases with no significant difference between the two groups ( $p=0.083$ ).

In plate group left side fracture was observed in 11 (44%) cases and right side fracture was observed in 14 (56%) cases. In k-wire group left side fracture was observed in 10 (40%) cases and right side fracture was observed in 15 (60%) cases with no significant difference between the two groups ( $p=0.77$ ).

In plate group Mechanism injury was FOOSH was in 9 (36%) cases and RTA was in 16 (64%) cases. In k-wire group FOOSH was in 11 (44%) cases and RTA was in 14 (56%) cases with no significant difference between the two groups ( $p=0.564$ ).

*Operative data:*

Operative time in plate group was  $24.8 \pm 3.58$  min. and in k-wire group was  $22.4 \pm 3.35$  min. with significant decrease in k-wire group ( $p=0.02208$ ).

Hospital Stay in plate group was  $2.89 \pm 1.85$  days and in k-wire group was  $1.87 \pm 1.22$  days with significant decrease in k-wire Group ( $p=0.03036$ ).

Table (1): Basal Characteristics of included subjects.

	Plate group (N=25)	K. Wire group (N = 25)	p- value
Age (years)	43.4±15.67	43.24±15.79	0.9715
Sex N (%):			
Male	18 (72%)	12 (48%)	0.083
Female	7 (28%)	13 (52%)	
Side fracture N (%):			
Left	11 (44%)	10 (40%)	0.77
Right	14 (56%)	15 (60%)	
Mechanism injury N (%):			
FOOSH	9 (36%)	11 (44%)	0.564
RTA	16 (64%)	14 (56%)	

Blood Loss in plate group was 37.88±11.83ml and in k-wire group was 30.76±12.02ml with significant decrease in k-wire Group ( $p=0.04539$ ).

Operative data of included subjects was significantly better in k-wire group.

**PRWE wrist Score:**

Scoring was done pre and post-operatively 1, 3, 6, 12 month later using PRWE wrist.

There was significant improvement in plate group compared with k-wire group regarding PRWE wrist score in post-operative first and third months ( $p<0.05$ ).

There was no significant difference regarding PRWE wrist Score Preoperative or postoperative 6 & 12 months in both groups ( $p>0.05$ ).

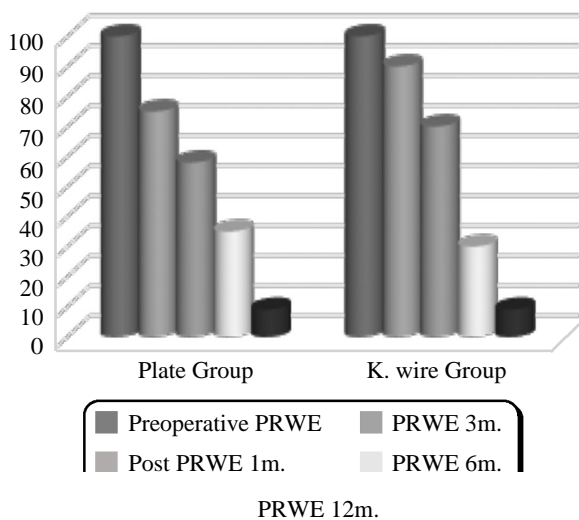


Chart (1): PRWE wrist Score statistics in both groups.

**Range of motion (ROM):**

The flexion in plate group was  $<10 \pm 1.2$  preoperatively, after the 3<sup>rd</sup> month it was  $60 \pm 1.1$ , after the 6<sup>th</sup> month it was  $77 \pm 1.2$  and after one year

was  $80 \pm 1.1$  with significant increase in each time compared to baseline ( $p<0.05$ ). While in K-wires group flexion was  $<10 \pm 1.3$  preoperatively, after the 3<sup>rd</sup> month was  $53 \pm 2.93$ , after the 6<sup>th</sup> month was  $76 \pm 2.83$  and after one year was  $79 \pm 2.58$  with significant increase in each time compared to baseline ( $p<0.05$ ).

In Plate group 3<sup>rd</sup> month extension was  $<5 \pm 2.1$  preoperatively after the 3<sup>rd</sup> month was  $60 \pm 1.7$ , after the 6<sup>th</sup> month was  $60 \pm 1.7$  and after one year was  $80 \pm 1.1$  with significant increase in each was  $65 \pm 1.6$  with significant increase in each time compared to baseline ( $p<0.05$ ). While in K-wires group extension was  $<5 \pm 1.8$  preoperatively, after the 3<sup>rd</sup> month was  $54 \pm 3.51$ , after the 6<sup>th</sup> month was  $64 \pm 2.54$  and after one year was  $89 \pm 2$  with significant increase in each time compared to baseline ( $p<0.05$ ).

The preoperative ulnar deviation in Plate group was  $<5 \pm 1.5$ , after the 3<sup>rd</sup> month was  $21 \pm 3.52$ , after the 6<sup>th</sup> month was  $44 \pm 3.3$  and after one year was  $49 \pm 2.73$  with significant increase in each time compared to baseline ( $p<0.05$ ). While in K-wires group was  $<5 \pm 1.3$ , at after the 3<sup>rd</sup> month was  $30 \pm 2.1$ , after the 6<sup>th</sup> month was  $30 \pm 2.1$  and after one year was  $45 \pm 2.3$  with significant increase in each time compared to baseline ( $p<0.05$ ).

The preoperative radial deviation in Plate group was  $<5 \pm 2.1$ , after the 3<sup>rd</sup> month was  $10 \pm 2.3$ , after the 6<sup>th</sup> month was  $15 \pm 1.1$  and after one year was  $20 \pm 1.1$  with significant increase in each time compared to baseline ( $p<0.05$ ). While in K-wires group was  $<5 \pm 1.3$ , after the 3<sup>rd</sup> month was  $7 \pm 2.61$  after the 6<sup>th</sup> month was  $14 \pm 2.94$  and after one year was  $19 \pm 2.81$  with significant increase in each time compared to baseline ( $p<0.05$ ).

At the end of the first year we didn't find any significant different regarding the ROM between both groups ( $p>0.05$ ).

**Wrist radiologic assessment:**

Postoperative radial length in plate group was  $10.23 \pm 1.3$  and in k-wire group was  $11.23 \pm 2.3$ . The postoperative volar tilt in plate group was  $11 \pm 1.9$  and in k-wire group was  $10.4 \pm 1.6$  54. The postoperative inclination in plate group was  $22.1 \pm 2.1$  and in k-wire group was  $21.3 \pm 4.1$ . There was no significant difference between the two groups regarding Postoperative Radial Length ( $p=0.064$ ), Postoperative Volar tilt ( $p=0.233$ ) and Postoperative inclination ( $p=0.389$ ).

**Complications:**

In plate group infection was observed in one patient (4%) and Complex regional pain syndrome (CRPS) was observed in 1 patients (4%). In k-wire group infection was observed in 1 patient (4%) case and CRPS was observed in 2 patients (8%). There was no significant difference between both groups regarding infection ( $p=0.99$ ) or CRPS ( $p=0.55$ ).

Table (2): ROM plate statistics.

ROM	Preoperative ROM	Post ROM	ROM 3m	ROM 6m	ROM 12m
Flexion	<10±1.2*	In splint	60±1.1*	77±1.2*	80±1.1*
<i>p</i> -value			<0.0001	<0.0001*	<0.0001
Extension	<5±2.1*	In splint	60±1.7*	65±1.6*	90±1.2*
<i>p</i> -value			<0.0001	<0.0001	<0.0001
Ulnar deviation	<5±1.3*	In splint	30±2.1*	45±2.3*	50±1.1*
<i>p</i> -value			<0.0001	<0.0001	<0.0001
Radial deviation	<5±2.1*	In splint	10±2.3*	15±1.1*	20±1.1*
<i>p</i> -value			<0.0001	<0.0001	<0.0001

Table (3): ROM wire statistics.

ROM	Preoperative ROM	Post ROM	ROM 3m	ROM 6m	ROM 12m
Flexion	<10±1.3	In splint	53±2.93	76±2.83	79±2.58
<i>p</i> -value			<0.0001	<0.0001	<0.0001
Extension	<5±1.8	In splint	54±3.51	64±2.54	89±2.6
<i>p</i> -value			<0.0001	<0.0001	<0.0001
Ulnar deviation	<5±1.5	In splint	21±3.52	44±3.3	49±2.73
<i>p</i> -value			<0.0001	<0.0001	<0.0001
Radial deviation	<5±1.3	In splint	7±2.61	14±2.94	19±2.81
<i>p</i> -value			0.0022	<0.0001	<0.0001



Fig. (3): Wrist ROM.

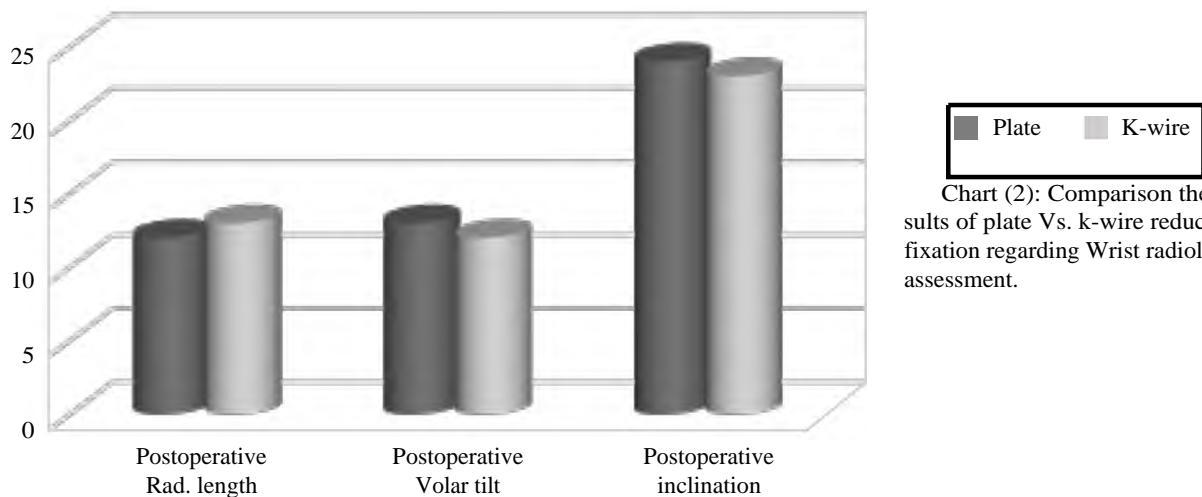


Chart (2): Comparison the results of plate Vs. k-wire reduction fixation regarding Wrist radiologic assessment.

### Case presentation:

A male patient 42 years old had closed RT DER Fracture after FOOSH. On admission, clinical examination was done plain X-rays. He was prepared for surgery next day admission fracture was fixed by K wires.

The average time for the operation was 20 minutes. Patients stayed in the hospital only for one day. Blood loss was 20ml postoperative PRWE was 90. PRWE 3 months post operatively was 60. PRWE 6 months post operatively was 30. PRWE 12 months post operatively was 0 for ROM measured by goniometer at 12 months post operatively flexion was 85. Extension was 75. Ulnar deviation was 50. Radial deviation was 20.

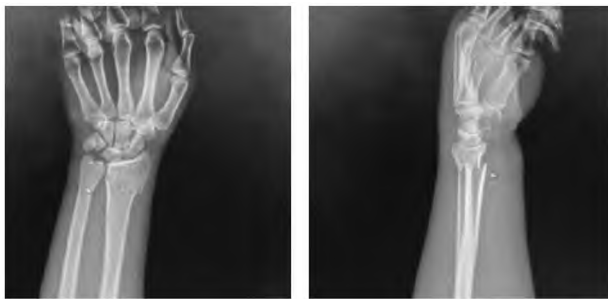


Fig. (4): AP and lateral views of DER fracture of case (preoperative).

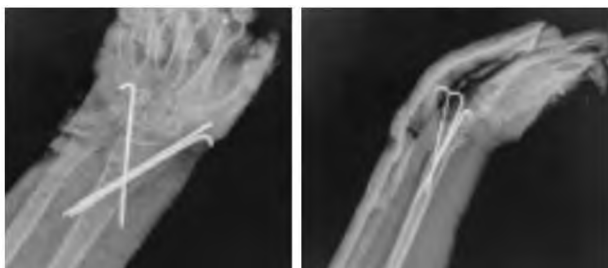


Fig. (5): AP and lateral views of DER fracture of postoperative.

## Discussion

The distal radial fracture is a common injury that requires anatomical reduction restoring the angles for optimum results functionally, there is variety of surgical management options, but this study compared the functional and radiological results of volar plate vs. k-wire fixation for unstable extra articular distal radius fractures.

Recently an increased incidence of distal radial fractures was noted due to rising road collision. About 60% of patients involved in this study were due to road collision, which was similar to Ffitoussi & SP Chow [6]. The increased incidence of road collision explains the young age of the involved patients mean (43.4±15) years.

This study found superior results with k wires regarding the operative duration, lost blood and hospitalization. While plate group showed better PRWE wrist score in first and third post-operative months. There was significant improvement in regarding ROM at 3 months post-operative in the plate group when compared to k-wires group, but there was no statistical difference in wrist function or pain as denoted by ROM and PRWE and between those treated by K-wire fixation and those treated by plate fixation at 6, 12 months postoperatively. There was no statistical significance in complications rate. Our study in concordance with the result of Rozental et al., who operated 45 patients with extraarticular distal radial fracture internal fixed by plate vs. K wire and concluded that the patients who had been managed plate fixation had ROM, stronger hand grip, and lower DASH scores in the early post-operative period. Once a year had passed since the accident, these disparities had disappeared, and there was no statistical significant difference between the treated groups regarding functional or radiological results [7].

The distal radius acute fracture fixation trial's published a multicenter study in the united kingdom involved 461 patients and didn't recommend the usage of volar locking plates, which is growing quickly. Patients were excluded from their study if the patient had intra-articular fracture that would get better results from plate fixation. At 3, 6, and 12 months, the patients were checked on and assessed using PRWE and DASH. The difference had no statistical significance regarding the functional outcome between groups, and there was also no difference in complication rates [8].

Our study results weren't matched with Marcheix et al., [9] who assigned 103 patients, all of whom were older than 50. Fifty patients had volar plate fixation whereas 53 patients had closed pinning. At 3-, 6-, 12- and 26-weeks following surgery, clinical and radiological results were compared. Those who were stabilized with wires experienced loss of reduction more frequently. Functional outcomes, as measured by Herzberg and DASH scores, were higher in the plate group at 26 weeks, which can be explained by short term follow-up of the patients in comparison with our study.

Volar locking plates have undoubtedly become more popular as a result of advertising by supplying companies and the accelerated functional improvements that were noted. The earlier return to work and sports participation for young patients must be judged against the expense of the implants. The price of two k-wires, according to a cost analysis study, is 100 Egyptian pounds, while the cost of used volar locking plate was 5000 Egyptian pounds. When the extra costs for operating room time was taken into account, the cost difference between the treatment groups will increase [10].

**Conclusions:** This study demonstrates similar clinical functional and radiological outcomes for T plate and K-wire fixation for extra articular dorsally displaced distal end radius fractures, in the short and intermediate term follow-up. For simple fractures, percutaneous pinning remains a valid, less invasive, cost effective option.

Complex fractures that cannot be reduced by closed means and comminuted extra-articular fractures where plating used to maintain the radial length, should be the indications for volar plating.

### References

- 1- ARK J. and JUPITER J.B.: The rationale for precise management of distal radius fractures. Orthop. Clin. North Am. 1993; 24: 205–10, 2018 Royal Australasian College of Surgeons.
- 2- YOULDEN et al.: Adam, Greenspan: Orthopedic imaging: A practical approach. Beltran, Javier (Professor of radiology) (Sixth ed.). Philadelphia. ISBN 9781451191301. OCLC 876669045, 2015.
- 3- BRIAN D., WHITE M.D., JASON A., NYDICK D.O.D., AWWNE KARSKY M.S., BAILEE D., WILLIAMS B.S., ALFRED V., HESS M.D., JEFFREY D. and STONE M.D.: The Journal of Hand Surgery Volume 37, Issue 10, October, Pages 2035-2040, 2012.
- 4- BROWN DAVID E. and NEUMANN RANDALL D.: Orthopedic Secrets. Elsevier Health Sciences, p. 182. ISBN 9781560535416, 2004.
- 5- LOISEL F., BOURGEOIS M., RONDOT T., NALLET J., BOECKSTINS M., ROCHET S., LECLERC G., OBERT L. and LEPAGE D.: Treatment goals for distal radius fractures in 2018: Recommendations and practical advice. European journal of orthopaedic surgery & traumatology: Orthopedietraumatologie, 2018 Dec [PubMed PMID: 29663104]
- 6- FITOUSSI F. and CHOW S.P.: Treatment of displaced intra articular fractures of the distal end of radius with plates. J. Bone Joint Surg (A), 79-A (9): 1303-11, 1997.
- 7- ROZENTAL T.D., BLAZAR P.E., FRANKO O.I., CHACKO A.T., EARP B.E. and DAY C.S.: Functional outcomes for unstable distal radial fractures treated with open reduction and internal fixation or closed reduction and percutaneous fixation. A prospective randomized trial. J. Bone Joint Surg. Am., 91: 1837–46, 2009.
- 8- SHYAMALAN G., THEOKLI C., PEARSE Y., et al.: Volar locking plates versus Kirschner wires for distal radial fractures-A cost analysis study. Injury, 40 (12): 1279-81, 2009.
- 9- MARCHEIX P.S., DOTZIS A., BENKÖ P.E., et al.: Extension fractures of the distal radius in patients older than 50: A prospective randomized study comparing fixation using mixed pins or a palmar fixed-angle plate. Journal of Hand Surgery: European, Volume 35 (8): 646-51, 2010.
- 10- COSTA M.L., ACHTEN J., PARSONS N.R., et al.: On behalf of the DRAFFT Study Group. Percutaneous fixation with Kirschner wires versus volar locking plate fixation in adults with dorsally displaced fracture of distal radius: randomised controlled trial. BMJ, 349, 2014.

## دراسة مقارنة للنتيجة الوظيفية لتثبيت كسر نهاية عظمة الكعبرة باستخدام اسلاك معدنية من خلال الجلد مقابل تثبيت الجهة الامامية للكعبرة باستخدام الشرائح والمسامير في عينة من المرضى المصريين

تعتبر كسور نهاية الكعبرة هي من أكثر الكسور شيوعاً في الطرف العلوي للجسم وتمثل ١٧٪ من جميع إصابات الطرف العلوي. لوحظ أن هناك اتجاه متزايد نحو التثبيت الوظيفي باستخدام الشرائح والمسامير بدلاً من التثبيت الداخلي باستخدام الاسلاك المعدنية، التي ظلت لفترة طويلة الطريقة المثالية لتثبيت في مثل هذه الإصابات.

هذه دراسة مقارنة عشوائية مستقبلية على ٥٠ مريضاً يعانون من كسر نهاية الكعبرة خارج المفصل غير مستقر مقسمين إلى مجموعتين متساويتين. تم علاج المجموعة الأولى بواسطة رد مغلق وتثبيت باستخدام أسلاك معدنية اما المجموعة الثانية رد مفتوح وتثبيت بشريحة ومسامير. تم متابعة المرضى لمدة عام سريريًا ووظيفيًا بالإضافة إلى الأشعة.

اظهرت النتائج ان هناك تحسن ملحوظ مبكر مجال الحركة ونقاط تقييم المريض خلال الثلاث أشهر الأولى في مجموعة الشرائح والمسامير، لكن لم يكن هناك فرق ذو أهمية إحصائية في نهاية السنة الأولى بين المجموعتين.

وقد استنتجنا ان تثبيت كسر نهاية الكعبرة خارج المفصل غير مستقر بواسطة رد مغلق وباستخدام أسلاك معدنية هي تقنية آمنة ورخيصة وسهلة للحفاظ على الانزلاق في حالات الكسور النهائية للرسغ.