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K-WIRE FIXATION VERSUS, VOLAR PLATE FOR EXTRA-ARTICULAR DISTAL RADIUS FRACTURE IN ELDERLY

By

Ahmed Mohamed Husin Oraby, Mohamed Mohamed Bissar and Mohamed Fathy El-Halawany

Department of Orthopedic Surgery, Faculty of Medicine, Al-Azhar University

Corresponding author: Ahmed Mohamed Husin Oraby,

Mobile: 01013946602, **E-mail:** ahmedhusinoraby@gmail.com

ABSTRACT

Background: Distal radius fractures in the elderly population are very common injuries, and unique management issues in the treatment of these fractures. Distal radius fractures in osteoporotic bone have greatly diminished stability. There are often bone impaction and fracture fragmentation.

Objective: To evaluate clinical and radiological outcomes of management of patients with extra-articular distal radius fractures in elderly by comparison between K-wire fixation vs. volar plate.

Patients and Methods: Our study made a comparison between 2 types of Operative management of fracture K-wire and volar plate. At the Department of Orthopaedic Surgery, Al-Azhar University Hospitals, 20 patients with extra-articular distal radius fracture, with ages ranged above 60 years old. Ten patients treated by K-wire and casting for 6 weeks, then removal of k-wire and started Range of Motion (ROM) from 6-8 weeks, An Other group of Ten patients were management by Volar locked Plate with below elbow slab for 2 weeks, then removal of slab and start ROM. During the follow up period, clinical evaluation revealed significant improvement in pain, movement and grip strength. The functional outcome by Quick DASH Score and MAYO Score.

Results: In K-wire group, the mean age was 65.40 and high incident in female (60.0%). K-wire was removed after 6-8 weeks, and all patients were followed up of functional outcome for 6 months. The result of 3months were Q-DASH score (35.64) and MAYO score (69.00). After 6 months were Q-DASH score (17.00) and MAYO score (82.00). the complications of K-wire in this study were pin tract infection (40%) loosening (20%) and Complex regional pain syndrome (CRPS) (20%). In Volar Plate group the mean age was 65.20, and high incident in male (80.0%). and suture removal after 2 weeks and started Rang of Motion (ROM), All patients were followed up of functional outcome for 6 months. The result of 3 months Q-DASH score (17.12) and MAYO score (85.00), and after 6 months Q-DASH score (10.90) and MAYO score (91.00). The complications were ugly scar (20%) and CRPS (20%).

Conclusion: Volar plates were more rigged fixation and highly united rate than k-wire. It's allowed early ROM and quickly returns to functional. On follow up for more time, no real difference of functional outcome between the two methods of management.

Key words: Distal radius, Extra-articular, Fixation, Fracture, Kirschner, K-wire, Wrist, Volar Plate, MAYO Score, Q.DASH Score.

INTRODUCTION

Fractures of the distal radius comprise almost one-sixth of all fracture cases encountered in the emergency department. They are common injuries, particularly in the elderly population, Reduction bone mineral density (BMD) has been identified as one of the most significant risk factors for distal radius fracture *(Øyen et al., 2011).*

These fractures have a bimodal age distribution, with young adults and the elderly being the most affected, in the elderly, they result more commonly from low-energy falls than from high-energy trauma. Eighty-five percent of women who suffer distal radius fractures have been shown to have low bone mineral density and 51% have osteoporosis, with the growing number of elderly patients in the developed world, the incidence of these fractures will only increase *(Al-Amin et al., 2018).*

Distal radius fractures in elderly people tend to displace because they have osteoporotic bone. In a study involving 125 women aged over 50 years, who suffered distal radius fractures from low-energy trauma, measures of fracture displacement were compared with bone mineral density, from radiographic measurements, a significant association of increasing deformity with lower bone mineral density was found *(Blakeney and william, 2010).*

A number of studies have looked at predictors of instability in distal radius fractures treated conservatively, In a series of 4000 distal radius fractures, one of the most significant predictors of instability was increasing age *(Bravo et al., 2021).* A prospective study of 645 Colles' fractures treated conservatively also found that age was one of the most important predictors of displacement, age above 60 years was a predictor of failure in a study of 112 conservatively managed fractures as well *(Katrina et al., 2021).*

The surgical option for fixation this fracture followed by early motion, the gold standard of periarticular fracture care, the widespread knowledge of the importance of early motion in hand rehabilitation.

The aim of this study was to assess the functional outcomes of the patients with displaced extra articular distal radius fractures treated by K-wire fixation or Volar plate.

PATIENTS AND METHODS

After approval of the medical ethical committee at the Department of Orthopedic Surgery, Al-Azhar University Hospitals, 20 patients with extra-articular distal radius fracture were included, with or without ulnar styloid fracture AO class A2-A3 in elder patients, with ages ranged above 60 years old were included in this study.

Exclusion criteria: All patients with associated forearm fractures or exposed fracture, intra-articular distal radius fracture, pathological fractures and patients with previous wirst surgery.

The patient's clinical data fulfilling the inclusion criteria were evaluated including history from the patient and physical examination. Radiological examinations included anterior-posterior (AP) view and lateral view of elbow, forearm and wrist. Computed tomography (CT) was taken in

some cases to exclude articular extension of the fractures.

K-wire Technique: Under regional or general anesthesia, the first step was to reduce the fracture (under the C-arm), using traction and counter-traction, in association with ulnar flexion and deviation to neutral, and recovered the height of the radius through ligamentotaxis. Once an acceptable reduction was achieved and confirmed with C-arm, 1.5 mm to 2 mm thick K-wire, two wires were introduced through the styloid process of the radius, crossing the fracture focus proximally, and another dorsal wire, through the ulnar notch of the radius, after making a stab incision at the entry point. K-wires were engaged in the opposite cortex of the proximal fragment to achieve maximum stability of fixation **(Figure 1)**.

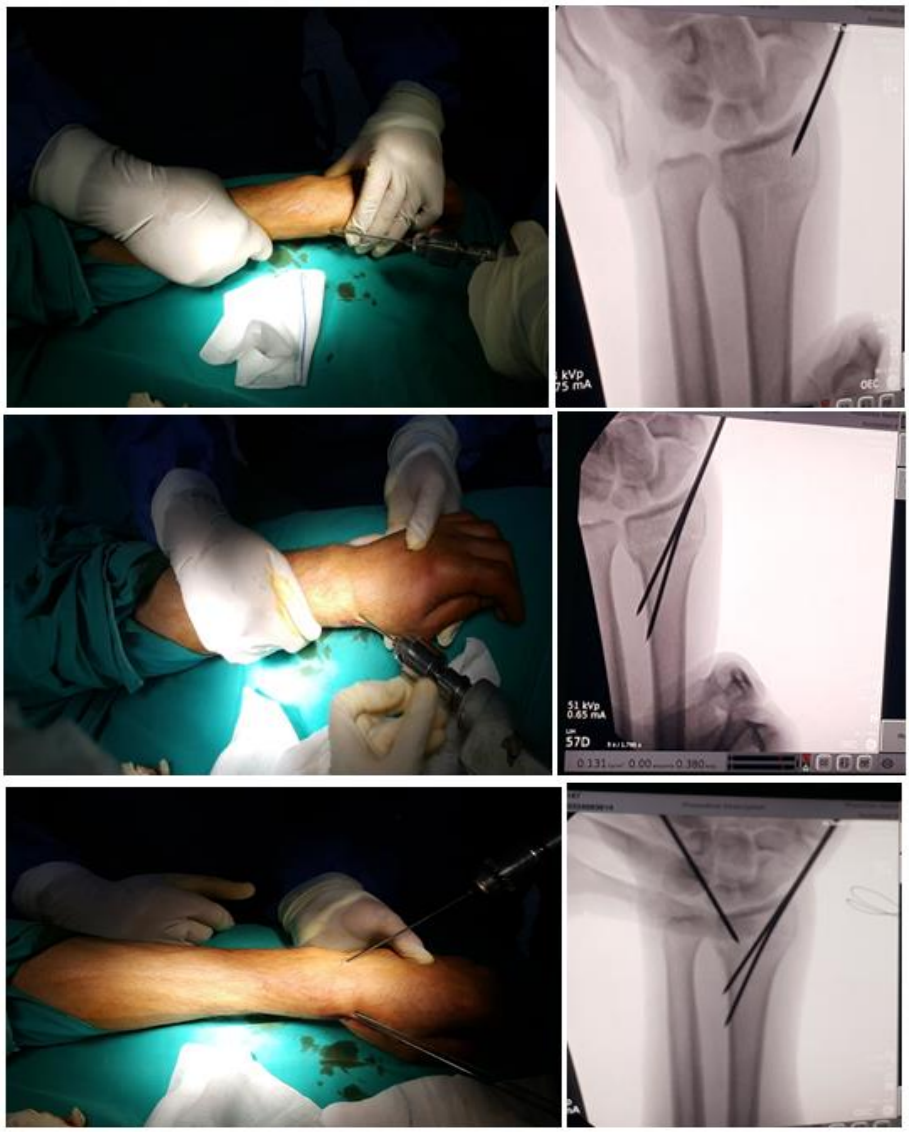

Figure (1): K-wires insertion

K-wires were bent at a right angle and cut short outside the skin for easy removal. A sterile dressing including sponge padding was applied around K-wire. A well- pad applied around K-wire. A well- padded cast or splint is placed postoperatively to maintain the stability.

The cast was left in brace for 4-6 weeks. An X-ray documented fracture position at this time. The K-wires were usually removed at about 6-8 weeks **(Figure 2)**.

Volar Plate Technique: Under general or regional anesthesia in supine position, the involved hand was kept on the side table or table side arm. The fracture was exposed and tourniquet control.

Modified Henry approach was made by a longitudinal incision overlying the tendon of flexor carpi radialis (FCR), beginning just above the skin crease of the wrist and extended up the volar aspect of the forearm. The length of the incision depended on the nature of the fracture pathology and the length of the plate to be used for fixation—7 cm was usually sufficient.

The sheath of flexor carpi radialis was opened and the tendon was retracted towards the ulna. The incision between the flexor pollicis longus and the radial artery was deepended. Care was taken to avoid damaging the radial artery on the radial side and the palmar cutaneous branch of the median nerve on the ulnar side.

The pronator quadrates muscle was exposed through the FCR sheath floor, and muscle was elevated using an L-shaped sharp dissection. The horizontal limb was placed at the watershed line. This lied a few mm proximal to the joint line. The position of the joint line was determined by a hypodermic needle placed in the joint. The vertical limb is incised on its radial border, exposing the distal radius, and stripped off the distal radius together with the periosteum.

The fracture site was exposed and the hematoma and soft tissue were removed. The fracture and the articular surface was reduced anatomically by traction and derotation and provisionally held in place with small bone holding forceps or preliminary K.wire **(Figure 2)**.

Figure (2): Fracture site

Self-locked plate was applied and checked for proper position. The volar plate did not project above Watershed Line, and held by small plate holder or preliminary K-wires **(Figure 3)**.

Conventional screw was inserted in the oval plate hole, then locking sleeve was used to guide the drill bit, and locked screws was used to fix subarticular region first after measuring proper length of screws, then proximal screws was inserted by the same manner.

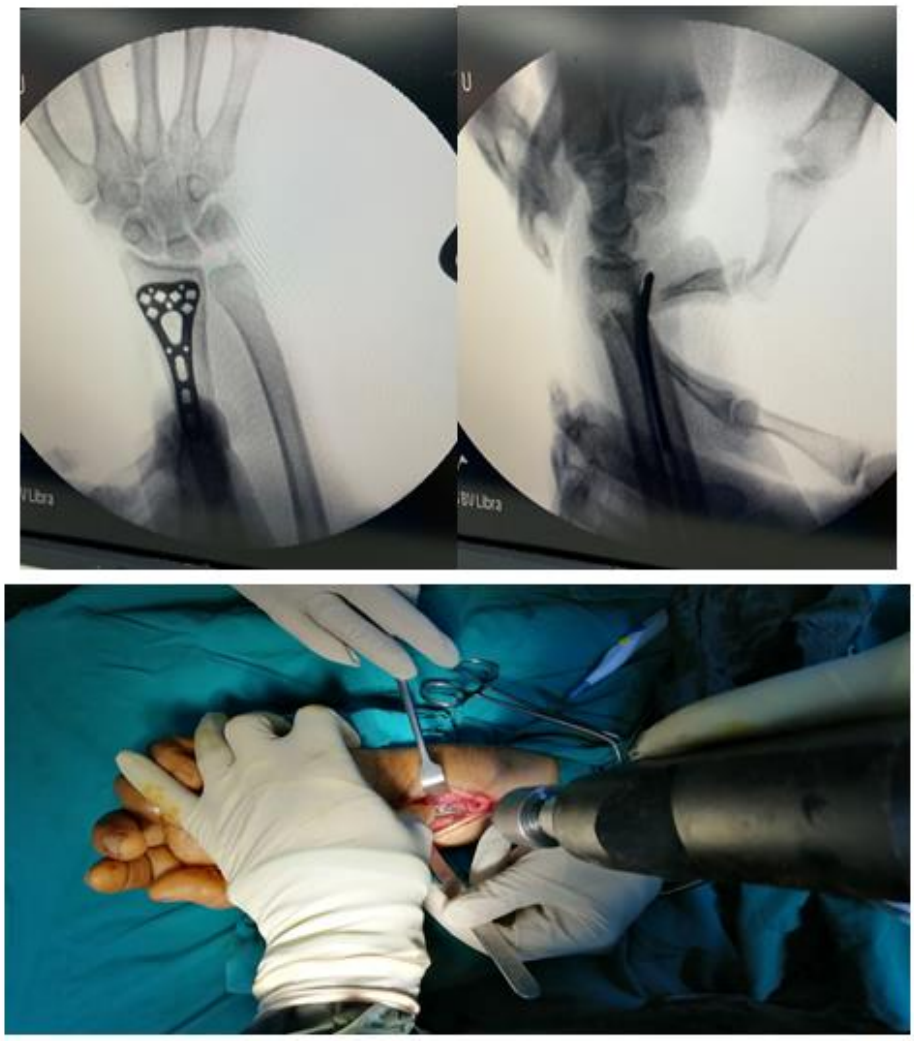

Figure (3): Plate position preliminary fixation

Rotation and angulation alignment were checked before and after internal fixation of the fracture by direct visualization **(Figure 4)**.

Figure (4): Antero-posterior and Lateral View post fixation

After internal fixation, the tourniquet was removed, followed by heamostasis then pronator quadrates was sutured back to cover the plate by wide loose sutures, and No drain was used in any case after good hemostasis, Closure of subcutaneous tissue by absorbable sutures then skin was closed by non-absorbable sutures. Below elbow slap was applied until stitches removal after 10 to 15 days, and started range of motion.

Evaluation performed at 4th week, 4th month, and 6th month for presence complications. We evaluated the postoperative range of motion in all directions using Q.DASH Score and MAYO Score at 3rd and 6th month.

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. According to the type of data qualitative represent as number and percentage, quantitative continues group represent by mean ± SD, the following tests were used to test differences for significance;. Difference and association of qualitative variable by Chi square test (X2). Differences between quantitative independent groups by t test, P value was set at <0.05 for significant results & <0.001 for high significant result.

RESULTS

There was statistically significant increase in female (60.0%) in K.W and increase in male (80.0%) in plate but there was no statistically significant difference in age according studied groups **(Table 1)**.

Table (1): Comparison between K.W and plate as regards demographic data

Parameters \ Groups		K.W (N=10)		Plate (N=10)		Chi square test/ Independent t test
		No	%	No	%	p value
Sex	Female	6	60.0%	2	20.0%	0.068
	Male	4	40.0%	8	80.0%	
Age	Mean± SD	65.40	4.03	65.20	3.74	0.910

There was no statistically significant difference between K.W and plate according co-morbidity **(Table 2)**.

Table (2): Comparison between K.W and plate as regards co-morbidity

Co-morbidity \ Groups	K.W		Plate		Chi square test
	No	%	No	%	p value
Asthmatic	0	0.0%	2	16.7%	0.225
CHD	2	14.3%	2	16.7%	
HTN	4	28.6%	4	33.3%	
DM	4	28.6%	0	0.0%	
No	4	28.6%	4	33.3%	

There was a statistically significant increase time of union (weeks) in K.W in comparison to plate. The mean time to union of K-wire patients was 23.60 weeks, while in plate patients was 15.20 weeks **(Table 3)**.

Table (3): Comparison between K.W and plate as regards times of union (weeks)

Time (weeks) \ Groups	K.W		Plate		Independent t test
	Mean	SD	Mean	SD	p value
Time to union (weeks)	23.60	4.50	15.20	3.43	<0.001

There was statistically significant great improvement of result outcome from 3rd month to 6th month in Q-DASH and MAYO score in follow up of K-wire fixation **(Table 4)**.

Table (4): Comparison between FU 3rd month and FU 6th month according K.W

Outcome \ FU (Months)	FU 3rd Month		FU 6th Month		Paired t test
	Mean	SD	Mean	SD	p value
Q.DASH	35.46	8.51	17.00	6.67	<0.001
MAYO	69.00	7.74	82.00	9.77	<0.001

There was a statistically significant little improvement of result outcome from 3rd month to 6th month in Q.DASH and MAYO score in follow up of plate fixation **(Table 5)**.

Table (5): Comparison between FU 3rd month and FU 6th month according plate

FU (Months) / Outcome	FU 3rd Month		FU 6th Month		Paired t test
	Mean	SD	Mean	SD	p value
Q.DASH	17.12	7.92	10.90	5.56	0.001
MAYO	85.00	7.45	91.00	7.74	<0.001

There was a statistically significant huge difference between K-wires and Plate in result outcome in 3rd month FU but no big difference in result out come in 6th month of FU **(Table 6)**.

Table (6): Comparison between K.W and plate as regards FU at 3rd month and 6th month according to Q.DASH and MAYO score

Outcome	FU (Months)	K.W		Plate		Independent t test
		Mean	SD	Mean	SD	p value
Q.DASH	**3rd Month**	**35.64**	**8.51**	**17.12**	**7.93**	**<0.001**
	6th Month	**17.00**	**6.67**	**10.90**	**5.56**	**0.039**
MAYO	**3rd Month**	**69.00**	**7.75**	**85.00**	**7.45**	**<0.001**
	6th Month	**82.00**	**9.78**	**91.00**	**7.75**	**0.035**

CASE PRESENTATION

K-wire Case:

Figure (5): X-ray after 2 weeks of fixation of K-wire case

Figure (6): X-ray after 6 months of fixation of K-wire case

Figure (7): Clinical photo of a case showing wrist flexion and extension

Figure (8): Clinical photo of a case showing wrist deviations

Volar Plate Case:

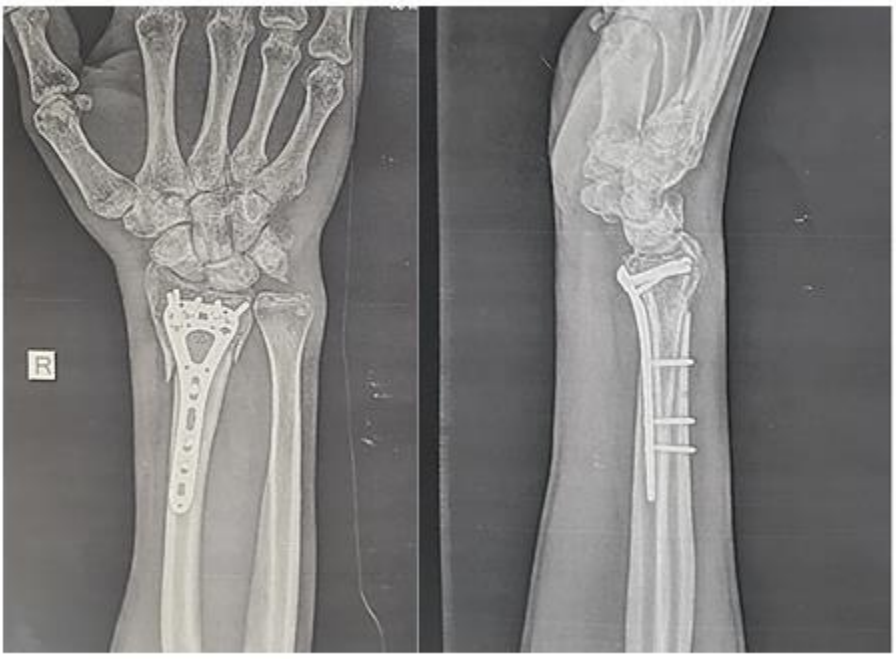

Figure (9): X-ray after 2 months of fixation of volar plate case

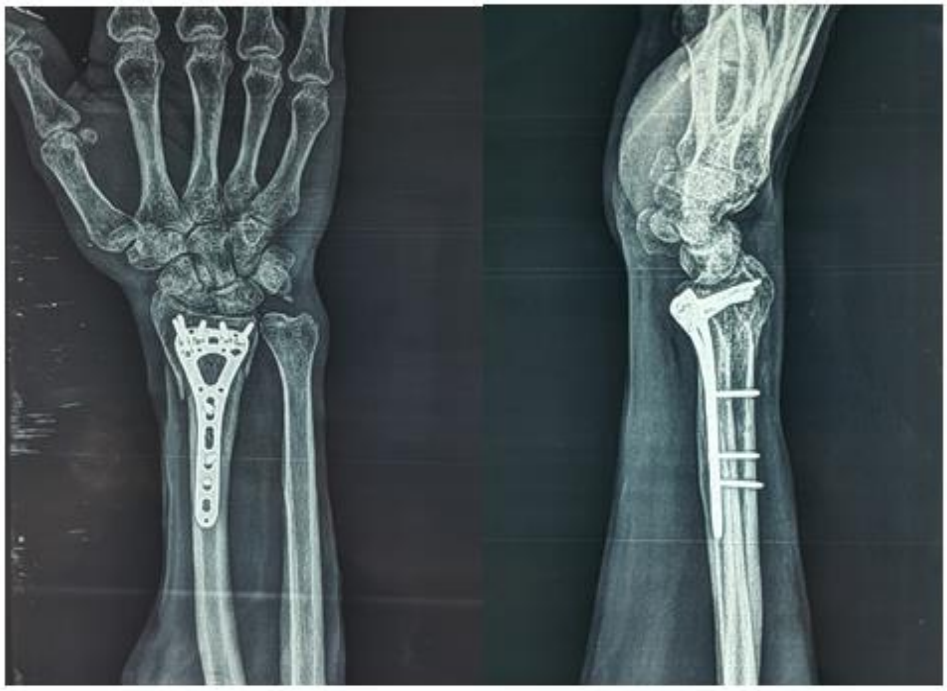

Figure (10): X-ray after 6 months of fixation of volar plate case

Figure (11): Clinical photo of volar plate case showing wrist flexion and extension

Figure (12): Clinical photo of volar plate case showing wrist deviations

DISCUSSION

Distal radius fractures in elderly people tend to displace because they have osteoporotic bone, a number of studies have looked at predictors of instability in distal radius fractures treated conservatively. A prospective study of 645 Colles' fractures treated conservatively found that age was one of the most important predictors of displacement. in other study looked at 60 fractures of the distal radius in a low-demand elderly population treated with anatomic reduction and cast immobilization, They found no correlation between fracture classification, initial displacement, and final radiographic outcome *(Toon et al., 2017)*.

The surgical option for fixation this fracture followed was by early motion. The gold standard of fracture care, assessed the functional outcomes of the elderly with displaced extra articular distal radius fractures treated by K-wire fixation or Volar plate.

This study was higher in males (60%), and this may be due to male involvement in outdoor activities, riding vehicles and heavy manual labor. Fall to ground (FTG) was the main mechanism of trauma in 60% of patients road traffic accidents (RTA) were in 40%. All cases were followed up for at least 6 months according to Q.DASH and MAYO score.

In K-wire group, the mean age was 65.40, and high incident in female (60.0%), and K-wire removal from 6-8 weak and all patients were followed up of functional outcome for 6 months. The result of 3 months Q-dash score (35.64) and MAYO score (69.00) and result after 6 months Q-dash score (17.00) and MAYO score (82.00), the complication of K-wire in this study pin tract infection was 40% loosening 20% and CRPS 20%.

By comparison of other study in K-wire, *Wong et al. (2010)* stated that the mean age 70y high incident in female 62% and follow up 12 month MAYO score (82.2). *Goehre et al. (2014)* study the main age 73.8 AO classification A2, A3 and C1 DASH score in 6 months (9.00) and in 12month (6.00). In systemic review of unstable distal radius fractures in the elderly *(Azzopardi et al., 2010)* and follow up of 12month studies DASH: 11.6/100 *(Diaz-Garcia et al., 2011)*.

In volar plate group the mean age was (65.20) and high incident in male 80.0%, suture removal after 2 weeks and start range of motion. All patients were followed up to functional outcome for 6 months. The result of 3 months Q-dash score was 17.12 and MAYO score was 85.00, and result after 6 months Q-dash score was 10.90, and MAYO score was 91.00. The complication ugly scar 20% and CRPS 20%.

In other study of volar plate, *Goehre et al. (2014)* showed that the main age 75 AO classifications A2, A3 and C1 DASH score in 6 months (11.00) and in 12 months (7.00). Mulders et al. (2019) showed that mean age 59y female 66% Classification A2 and A3 and follow up DASH score 3 months (6.7), 6 months (5.8) and 12 months (2.5). In systemic review, Chan et al. (2014) stated that mean age 71.5 female 85% follow up 12month DASH score (6.7). In other systemic review of unstable distal radius fractures in the elderly follow up 12month DASH score 7.1/100 *(Diaz-Garcia et al., 2011)*.

CONCLUSION

After reviewing the result, it is clear that our study and other studies Volar plate was more rigged fixation and highly united rate than k-wire, and allowed early ROM and quickly return to functional. On follow up for more time, no real difference of functional outcome between the two methods in management.

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تثبيت بواسطة الأسلاك المعدنية مقارنة بإستخدام الشريحة الرَّاحيَّة لتثبيت كسر خارج المفصل لأسفل عظمة الكعبرة في كبار السن

أحمد محمد حسين عرابي، محمد محمد بيصار، محمد فتحي الحلواني

قسم جراحة العظام، كليةالطب، جامعةالأزهر

خلفيه البحث: تعتبر كسور أسفل عظمة الكعبرة من الاصابات الشائعة في كبار السن، والتعامل معها يحتاج لطريقة خاصة حيث أن كبار السن يعانون من هشاشة العظام والتي تجعل هذا الكسر يميل إلي الانخساف أو التفتت.

الهدف من البحث: مقارنة النتائج الوظيفية بين تثبت الكسر بواسطة الأسلاك المعدنية أو بإستخدام الشريحة الرَّاحيَّة.

المرضي وطرق البحث: قامت دراستنا باجراء مقارنة بين تثبيت كسر أسفل عظمة الكعبرة في كبار السن بواسطة الأسلاك المعدنية أو بإستخدام الشريحة الرَّاحيَّة، وتم معالجة 20 مريضا من كبار السن يعانون من كسر أسفل عمظة الكعبرة بقسم جراحة العظام بجامعة الأزهر, علي مدار عام و ستة أشهر من يناير 2020 حتي يونيو 2021 ومتابعة وتقييم كل مريض علي مدار ستة أشهر. وقد ثم معالجة عشرة مرضي بواسطة التثبيت باستخدام الأسلاك المعدنية مع عمل جبس لمدة 6 أسابيع ثم رفع الجبس و الأسلاك المعدنية لبدء حركة الرسخ من الأسبوع السادس إلي الأسبوع الثامن. كما ثم معالجة عشرة مرضي بواسطة التثبيت باستخدام الشريحة الرَّاحيَّة وجبيرة لمدة أسبوعين, ثم رفع الجبيرة وبدء الحركة. وأثناء فترة المتابعة تم تقييم تحسن الألم والحركة وقوة القبضة وتم التقييم الوضع الوظيفي باستخدام تقيم كيو-داش و تقيم مايو في الشهر الثالث والشهر السادس.

نتائج البحث: في مجموعة التثبيت بواسطة الأسلاك المعدنية كان متوسط العمر 65.4 سنة ومعدل الاصابة أعلي في السيدات بنسبة 60% وتم رفع الأسلاك المعدنية وبدء الحركة من الأسبوع السادس وحتي الثامن؛ وكانت النتائج في الشهر الثالث وفقا لتقيم مايو (69.00) ووفقا لتقيم كيو-داش (35.64). وجاءت النتائج في الشهر السادس وفقا لتقيم مايو (82.00) ووفقا لتقيم كيو-داش (17.00)

وجاءت الأعراض الجانبية علي شكل عدوي موضعية بنسبة 40%، وانفكاك الاسلاك بنسبة 20% والم بالرسخ بنسبة 20%. أما في مجموعة التثبيت باستخدام الشريحة الرَّاحيَّة وكان متوسط العمر للمرضي(65.20) سنة ومعدل الاصابة أعلي في الرجال بنسبة 80%؛ وتم رفع الجبيرة وبدء الحركة من الأسبوع الثاني؛ وكانت النتائج في الشهر الثالث وفقا لتقيم مايو (85.00) ووفقا لتقيم كيو-داش (17.12) وجاءت النتائج في الشهر السادس وفقا لتقيم مايو (91.00) ووفقا لتقيم كيو-داش (10.90) وجاءت الأعراض الجانبية علي شكل الم بالرسخ بنسبة 20%.

الاستنتاج: التثبيت باستخدام الشريحة الرَّاحيَّة تعطي ثبات أكثر ومعدل التئام أسرع من التثبيت بواسطة الأسلاك المعدنية مما يسمح ببدأ الحركة والعودة للوضع الوظيفي في أسرع وقت، بينما جاءت النتائج مع المتابعة لفترة أطول أنه لا يوجد فرق كبير يذكر في نتائج الوظيفي لكلا الطريقتين في التثبيت.

الكلمات الدالة: كسر أسفل عظمة الكعبرة، أسلاك معدنية، الشريحة الراحية، كسور الرسخ، كسر كبار السن.