

Original Research Article

Evaluation of anatomico-radiological outcomes of volar plating for volar displaced distal radius fractures

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ABSTRACT

Background: The purpose of this study was to evaluate the anatomico-radiological outcomes of volar displaced distal radial fractures managed by volar plating.

Methods: It was a retrospective analytical and monocentric study performed within 8 years from 01 January 2014 to 31 December 2022; at the orthopedic and traumatological department of the university hospital Idrissa Pouye in Dakar (Republic of Senegal). All the patients managed by volar plating for volar displaced distal radial fractures during the period of the study were included; those managed through another treatment option, lost and whose folders could not be explored were excluded. Clinically, the patients were evaluated at the last follow up thanks to the Green and O'Brien scale; radiologically, the comparison was done among the preoperative, postoperative and the last follow up standard lateral view and antero-posterior view of the wrist.

Results: There were 37 patients (31 males and 6 females), the average age was 40 years old with a range from 18 to 66 years old. The minimum follow-up was 10 months. The clinical results showed at the last follow up an average functional Green and O'Brien scale of 80.2 with a range from 15 to 95. The postoperative radiological results showed the average radial frontal tilt of 21.3° with a range from 11° to 25°; the average radial sagittal tilt of 12.6° with a range from 10° to 15° and the average ulnar-radial index of 0mm with a range from -2 to +2. Three cases of radiocarpal arthrosis were found.

Conclusions: The volar plating of volar displaced distal radial fractures constitutes the indication of choice in order to restore the normal anatomy of the wrist and its function.

Keywords: Volar plating, Volar displaced distal radial fractures, Radial sagittal tilt, Radial frontal tilt, Ulnar-radial index

INTRODUCTION

The distal radius fractures (DRF) are one of the most common upper extremity fractures in adults.¹⁻⁶ They are defined as a disruption of the distal radius (DR) continuity with the fracture line laying between the radiocarpal articular line (RCAL) and a horizontal line passing 4 cm above the RCAL.⁷ They account for approximately 18% of all fractures, 47% of all upper limb trauma.^{3,8} These injuries are often seen in osteoporotic women related to low energy trauma and in young patients, related to high

energy trauma.^{4,8-13} They can be articular or extra-articular, volar displaced or dorsal displaced. The volar displaced distal radius fractures (VDDRF) are rare and often occur in young people related to high energy trauma. They are unstable fractures leading to vicious callus and precocious arthrosis.

Operative intervention using a volar locking plate (VLP) is currently the gold standard approach for DRF because it is able to restore intra-articular alignment and volar tilt by direct visualization of the fracture whilst providing a stable

and rigid fixation that reduces the rate of post-traumatic osteoarthritis.^{2,9,10} Less studies have been reported about the management of the VDDRF by volar plating (VP).

The purpose of this study was to evaluate the anatomic-radiological outcomes of the VDDRF by VP.

METHODS

It was a retrospective analytical study, performed at the orthopedic and traumatological department of the university hospital Idrissa Pouye in Dakar (Republic of Senegal) within 8 years from 01 January 2014 to 31 December 2022.

Were included in this study all the patients managed by VP for VDDRF during the period of the study; were excluded those managed with another treatment option, lost and whose folders could not be explored.

The diagnosis was based on clinical and radiological signs [lateral view (LV) and the antero-posterior view (APV)] with the measurement of the radial sagittal tilt (RST) and radial frontal tilt (RFT), and the ulnar-radial index (URI); which determined also the surgical indication: RST>14°, RFT<20°, URI (+2 mm) and the articular step (AS) greater than or equal to 2 mm.⁴

The surgery was performed by the senior surgeons, under general anesthesia and antibiotic prophylaxis. The patients were supinated on the ordinary table and the upper limb also supinated on the external table; a tourniquet was put on at the root of the limb.

After asepsis, all the limb was covered as shown in Figure 1a and b.

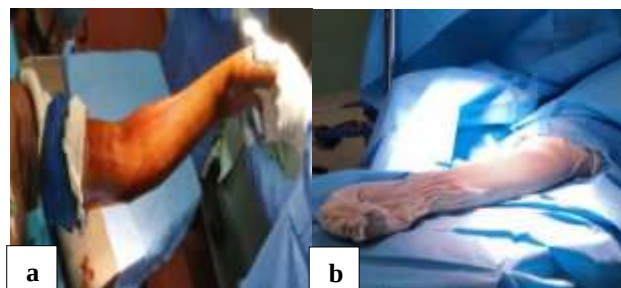


Figure 1: The procedures before surgery (a) asepsis and put on the tourniquet, and (b) the limb covered and supinated on the external table.

The Henry anterior approach was used; the radial artery seen and protected. The median nerve was seen also and its cutaneous branch; the pronator teres was laterally removed and reclined inside. The hematoma was removed, the reduction done and the volar plate put on; the first screw above the fracture line was put on in order to appreciate the reduction, afterwards, the epiphyseal and the diaphyseal ones were put on. The screwing was limited only to the metaphysis and diaphysis when the epiphyseal

comminution could not allow a satisfactory screwing; In the complex fractures, the use of plate was associated with intra-styloid pinning. At the end of the plating the surgical site was washed and closed as shown in Figure 2a-c.

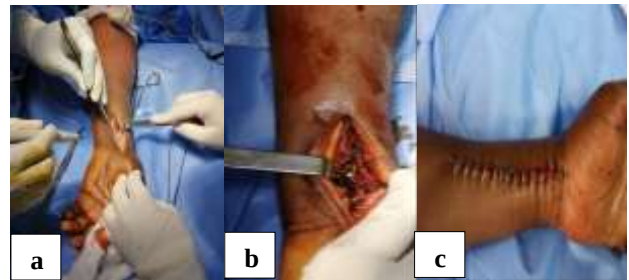


Figure 2: The surgical procedures (a) the approach, (b) the plating, and (c) the closure.

After the surgery, when the pain was relieved, the hand and the wrist mobilization was started. The weight bearing was forbidden until consolidation (3 months).

After the surgery, the X-rays allowed us to measure the angles and to appreciate the correction (RFT, RST, URI, AS and RCAL); and the position of the osteosynthesis implant. The consolidation duration was appreciated by the X-rays during the follow up at 21 day (d), d 45, 3 months (M), M6, and 1 year. The disappearance of the fracture line was defined as the consolidation criteria. At the last follow up the X rays allowed us to compare the preoperative parameters to postoperative and last follow up ones.

The clinical evaluation was based on the functional wrist scale of Green and O'Brien.

The patient folders and the hospitalization registers were used to collect the data.

The statistical package for the social sciences (SPSS) 29.0 software was used to analyze the data. The Zotero software was used to make the references.

The patient consents were obtained at the last follow up before the evaluation.

RESULTS

They were 37 patients (31 males and 6 females).

Road accidents were the most common, in 24 (64.9%) cases (Table 1).

The right side was affected in 20 (54.1%) cases, the left one in 17 (45.9%) cases. In terms of dominant side, the right sided people were 20 (95.2%) and one (4.8%) of left sided person.

In 31 (83.8%) cases, the fracture was extra articular and in 6 (16.2%) cases, were the articular ones (Figure 3 a-d).

Table 1: Circumstances of injury.

Circumstance	Frequency	Percentage
Road accident	24	64.9
Sports accident	4	10.8
Home accident	3	8.1
Work accident	3	8.1
Brawl	2	5.4
Aggression	1	2.7
Total	37	100


Figure 3: Lateral and anteroposterior views of the wrist, (a and b) extra articular fracture, (c and d) articular fracture.

The average RFT was 12.3° preoperatively; postoperatively and at the last follow up was 21.3° (Table 2).

Table 2: The RFT preoperatively, postoperatively and at the last follow up.

RFT	Minimum	Mean	Maximum
Pre-operative	6	12.3	18
Post-operative	11	21.3	25

The average RST was 18.9° preoperatively; postoperatively and at the last follow up was 12.6° (Table 3).

Table 3: The RST preoperatively, postoperatively and at the last follow up.

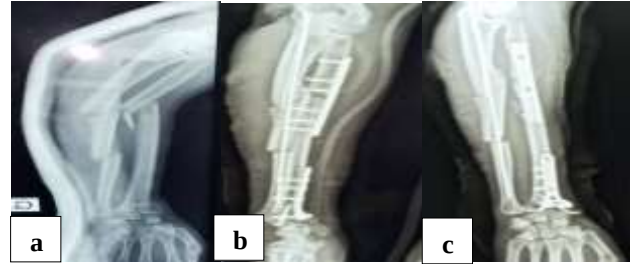
RST	Minimum	Mean	Maximum
Pre-operative	18	18.9	27
Post-operative	10	12.6	15
Last follow up	10	12.6	15

The average URI was +2.43 mm preoperatively; postoperatively and at the last follow up was 0 mm (Table 4).

Table 4: The URI preoperatively, postoperatively and at the last follow up.

URI	Minimum	Mean	Maximum
Pre-operative	+2	+2.43	+4
Post-operative	-2	0	+2
Last follow up	-2	0	+2

The associated lesions were: ulnar styloid fracture in 5 cases; diaphyseal fracture of the forearm bones, fracture of the humeral surgical neck and tendon rupture in a case each of them (Figure 4).


Figure 4 (a-c): VDDRf with associated lesions with diaphyseal fracture of forearm bones treated by intramedullary pinning of ulnar and double VP of the radius.

Only 21 patients were evaluated at the last follow-up; the average GREEN-O'BRIEN functional score was (80.2%) with a range from 15 to 95; The score was excellent in 6 cases, good in 9, average in 4 and poor in 2.

Three cases of arthrosis were seen, 2 cases of infection, and a case of complex regional pain syndrome and stiffness of the wrist (Figure 5a-d).


Figure 5: Complications after surgery, (a and b) radiocarpal arthrosis and radiological signs of complex regional pain syndrome on volar plate and ulnar pin, (c and d) infection of the operated site.

DISCUSSION

The average age of our patients was 40 years old with a range from 18 to 66 years old. An average age of 53.86 years old, with a range from 19 to 78 years old was found by Dabash et al which is a bit superior to ours.¹⁴

In this study 86.1% of our patients were males with a sex ratio of 5.16/1; The male gender is more involved in road accidents, which can explain the male predominance in our study. Other studies like that of Dabash et al found a female predominance in 66.7% of cases; Haddad et al found 78.9% of male.^{14,15} The road accidents were the most common, in 64.9% of cases. This can be explained by the increasing number of the roads in our cities, the usage of motorcycles, thickness of the roads, the

insufficient number of road signs and the failure to respect the road code. Our results are superior to those of Haddad et al, who found 31.5% of road accidents.¹⁵ Fifty-six point seventy-five (56.75%) of our patients suffered injury to their dominant wrist.

Dabash et al reported 56.5% of dominant wrist which is approximately similar to our result.¹⁴ In 16.2% of cases, the fracture was articular, the average RFT was 12.3°, the average RST was 18.9°, the average URI was +2.43 mm preoperatively.

The American Academy of Orthopaedic Surgeons recommends that operative treatment should be undertaken for non-geriatric patients with radial shortening of more than three millimeters, a dorsal tilt of more than ten millimeters, or intra-articular step of more than two millimetres.^{9,10}

We can say that the VP of the distal radius gives favorable results. The anatomo-radiological evaluation (RFT, RST and URI) was satisfactory in 97.2% cases; The RFT was 11°, the RST was 6° and the URI was positive in 2.7 % of cases, each of them, postoperatively.

In a meta-analysis comparing cast immobilization to internal fixation for DRF, the radiographic outcomes were generally better for the internal fixation group.¹⁶ Another meta-analysis, comparing five options to manage DRF, Overall, volar plating showed consistent good outcome for all four radiological measurements.¹⁷

In our series, the associated lesions accounted for 18.9% of cases; which can be explained by the high energy during the trauma, as reported in the literature. A superior result was found in another study.¹⁸

The evaluation of the wrist function according to the Green-O'Brien scale was excellent and good respectively in 6 cases et 9 cases so in 71.5%. A study using the quick DASH score, found at the latest postoperative follow-up, an average score of 20.9.¹⁴

In our study, 14.4% cases of arthrosis were found, 9.5% cases of infection, and 4.76% cases of complex regional pain syndrome and stiffness of the wrist. In a study of 3 groups, in group A consisting of 33 patients, 3.0% of joint stiffness was found; in group B consisting of 35 patients, 5.7% cases of joint arthrosis were found.¹⁹

This light rate of complications in our study is due to the anatomical reduction and stable fixation of the fracture and the earlier mobilization of the wrist as it is recommended in internal fixation; the cases of arthrosis were among those with articular fracture.

CONCLUSION

The volar plating of volar displaced distal radial fractures constitutes the indication of choice in order to restore the

normal anatomy of the wrist and its function with less surgical complications.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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