



Study of Results of Minimally Invasive Volar Plating for Fractures of Distal end Radius

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ABSTRACT

Introduction: Routinely distal radius fractures are treated using volar approach in which the pronator quadratus muscle is cut and fracture exposed, however minimally invasive approach by lifting the pronator quadratus and sliding the plate submuscularly provides advantage of early postoperative mobilization with comparable results in the long run. **Material and methods:** we studied the patients having distal radius fractures operated using minimally invasive volar approach with fixation with simple and locked plates. Patients were evaluated using Gartland & Werley score. **Results:** 25 patients were operated in 12 month period. AO classification was used. There were no significant complications regarding union rate and the postoperative hand function. There was a constant increase in the gartland & werley score during the follow up period. Saving the pronator quadratus muscle improved the pronation and grip power. **Conclusion:** minimally invasive approach of operating distal radius fracture by elevating the pronator quadratus muscle is a better and safe alternative to standard open volar approach. The rate of complications is also lesser with better early range of motion and grip strength. However this approach is not advantageous in comminuted intrarticular fracture which requires a more wide exposure.

KEYWORDS

Distal radius-minimally invasive (MIPO)-volar plate-fracture-Gartland & Werley score

INTRODUCTION:

Fracture of distal end radius continues to be one of the most common skeletal injuries treated by the orthopedic surgeons. These injuries account for approximately one sixth of all fractures seen in emergency room. It is the most common fracture of upper extremity with average incidence of 17.5% of fractures per year(1). The incidence is higher in female. Low energy injury such as fall on outstretched hand is the cause in 66 to 77% of the distal radius fractures. Road traffic accidents are a major cause of fracture in young adults(2). Restoration of radial length, radial tilt and congruity of articular surfaces is important for good functional results(3). However there are several controversies regarding the gold standard in its treatment. Various modalities includes closed reduction and casting, external fixation, orif via dorsal or volar approach. Dorsal plating have disadvantage of tendon tethering, tendon rupture and implant palpation. As a result volar plating gained upper hand in recent times with a flat palmar cortex for proper plate placement. 7).Disadvantages of traditional volar technique include(8) extensive soft tissue dissection, Periosteal injury, High rate of infection, Delayed union and non-union. The advantage of minimally invasive volar plating include minimal soft tissues stripping, lesser damage to vascularity, decrease tendon injury, nerve complications & vascular compromise(9) and better cosmetic results due to mini-incision.

MATERIALS AND METHODS:

We studied 25 patients with fractures of lower end of radius fracture operated between august 2013 to august 2015 by 3.5 locking volar plate through a minimally invasive pronator quadratus sparing approach in our institute. Patients were evaluated both radiologically and clinically at appropriate intervals. We used the AO/OTA Classification of distal radius fracture using plain radiographs. Out of 25 patients 16 were male & 9 female. The average age of presentation was 45.7 years. Right hand was affected in 16 & left in 9 patients. All surgeries were performed by the same surgical team.

Outcome measurements were determined using the **Gartland & Werley score modified by Sarmiento score.**

INCLUSION CRITERIA:

- Age more than 18 years.
- Closed/ unstable fractures.
- AO type A2, A3, B3& C1 fractures.

EXCLUSION CRITERIA:

- Skeletally immature patients or less than 18 years of age
- Open fractures.
- Fractures with diaphyseal involvement/ isolated radial styloid fractures.

SURGICAL TECHNIQUE:

All patient were operated in supine position under regional or general anaesthesia. The standard practice was preoperative prophylaxis by intravenous antibiotic, usage of tourniquet & cautery for hemostasis. The first step was traction & indirect reduction maneuvers under fluoroscopy. The reduction was hold with k wires temporarily if required. With forearm in supination an average of 20 to 30 mm incision either horizontal or vertical was kept on volar aspect of wrist over proximal flexor crease centering the FCR tendon. Plane was created between radial artery laterally & FCR, FPL & Median nerve medially. This exposes the entire Pronator Quadratus (PQ) muscle & the volar radial surface. Distal edge of PQ muscle was elevated using a periosteal elevator to form a sub muscular tunnel & the plate was slid under it. The plate was applied to the distal fragment and was used as a template to reduce the fracture fragments & restore the contour of the bone and identify proper measurements under fluoroscopy. 10 mm stab incision was kept over the proximal screws & one of the oval screws were locked through the belly of PQ to allow the plate's location to be corrected if necessary. Once correct reduction was achieved the remaining proximal locked screws were put into place. PQ was placed back to its place & subcuticular skin closure was done.

EVALUATION:

All patients were classified according to AO classification. Patients were followed up at 6 weeks, 3 months, 6 months and 1 year. Standard AP and lateral xrays were taken and were

evaluated for volar tilt, radial height, radial inclination & were assessed according to sarmientos modification of lindstorm criteria. Patients were examined for range of motion, grip strength, loss of reduction, wound and soft tissue complications. Gartland and werley score was used to evaluate functional recovery.

RESULTS:

25 patients were included in the study and none was lost during followup. Mean age was 45.7 years with sex ratio of 17 males and 8 females. Right hand was involved in 16 and left in 9. Fall on outstretched hand occurred in 64% and 36% suffered from RTA. AO classification was used to classify the fracture type, 8 patients were type A2,9 type A3,4 type B3 and 4 type C1. 92% had grip strength equal to the opposite side as measured by seeing the rise of mercury in sphygmomanometer.

Movements of wrist joint at final follow up:

PALMAR FLEXION:

| Palmer flexion (degree) | Number | Percentage |
|-------------------------|--------|------------|
| 76-85 (EXCELLENT) | 10 | 40% |
| 66-75 (GOOD) | 08 | 32% |
| 56-65 (FAIR) | 04 | 16% |
| 45-55 (POOR) | 03 | 12% |
| Total | 25 | 100% |

DORSIFLEXION

| Dorsiflexion (degrees) | Number | Percentage |
|------------------------|-----------|-------------|
| 66-85 (Excellent) | 20 | 80% |
| 56-65 (good) | 03 | 12% |
| 46-55 (Fair) | 02 | 8% |
| >45 (poor) | 00 | 00% |
| Total | 25 | 100% |



Clinical photos



Preop



Postop

COMPLICATIONS:

| | No. of patients (%) |
|--------------------------------|---------------------|
| Infection | 0 |
| Prominent Ulnar styloid | 2(08%) |
| Residual dorsal tilt | 3(12%) |
| Radial deviation of hand | 3(12%) |
| Carpal tunnel syndrome | 0 |
| Reflex sympathetic dystrophy | 1(4%) |
| Irritation/ rupture of tendons | 0 |
| Palpable hardware | 0 |
| Grip weakness | 2(08%) |

In our series, there were no cases of infection and neuro vascular injury probably the cause being proper hemostasis, min-

imal & careful dissection intraoperatively. Three patients had residual dorsal tilt both of whom showed post-operative fracture collapse during follow up. There were no cases of intra-articular penetration of joint leading to arthritis and rupture of tendons due to piercing of dorsal cortex by screws because of proper visualization with fluoroscopy. There were no cases of volar ruptures of tendon or palpable implant because of proper coverage of implant by Pronator Quadratus muscle. There also were no cases of Reflex Sympathetic Dystrophy due to early mobilization of patients.

FUNCTIONAL OUTCOMES:

There were no cases of nonunion in our series of patient. The gartland and werley score improved gradually in every followup In present study we could achieve 64 % of Excellent result, 24% of good result and 12% of fair result with an average of 3.3 score. Three of our patient had fair results due to fracture collapse because of improper reduction intraoperative in one case & redisplacement in two. These patients had dorsal tilt with restricted palmar flexion & ulnar styloid prominence. Patients without any complication reached a significantly higher score with overall 84% returning to their pre-injury occupation within 1 year follow-up.

DISCUSSION:

Distal radius fracture is a common emergency fracture, the need to surgically treat this has increased because non-surgical treatment frequently delays the patients return to activities of daily living. In this study we adopted a modified MIPO technique that uses a palmar locking plate through two small incisions to treat distal radius fractures. We excluded highly comminuted intra articular fractures because this fracture are not amenable to reduction by closed traction, they require a proper exposure of the joint surface & manipulation of fracture fragments for proper reduction which is only possible through open technique.

Conventional ORIF techniques require extensive exposure which decreases the bone's vascularity generating scarring and stiffness. Percutaneous sliding of implant decreases vascular & periosteal damage. Various clinical studies applying minimal invasive approaches have demonstrated fewer bone infection, less bone necrosis & decreased rate of refracture. Preserving the integrity of pronator quadratus is advantageous in restoring pronation strength & stability to distal radio ulnar joint. It also covers the plate protecting the flexor tendons.

All our patients had decreased wrist pain with good range of motion in the early postoperative period. Incidence of wrist swelling was also less which lead to better wrist function in the immediate post-op period. This result is due to the fact that the PQ muscle did not undergo significant damage & scarring, which allowed it to recover its function immediately post operatively. In the MIPO treated patients the surgical scar was not easily identifiable along the flexor crease at a glance. This has merits over conventional plating particularly for workers whose hands appear in public as well as in young females.

In our study we had 64% excellent, 24% good, 12% fair & 0% poor results as per Gartland and Werley criteria. Patients, who obtained excellent results, had no residual deformities or pain. Range of motion was within the normal functional range. They had no arthritic changes or other complications. Patients with good results had minimal residual deformities, pain and slight limitation. Rest of their findings was within acceptable parameters. Patients with fair results, along with residual deformity, pain and limitation also had pain in the distal radio-ulnar joint and complications such as radial deviation, ulnar styloid prominence.

The limitation of this study included a small sample size, the short followup time & the absence of a control group hence no conclusions can be made as to comparison with other types of treatment methods.

CONCLUSION:

Treatment of comminuted fractures by minimally invasive plate osteosynthesis technique appears to be a reliable procedure with encouraging results. It allows early mobilization and better functioning of hand with preservation of PQ giving a better range of motion, grip strength and lesser incidence of palpable implants and tendon ruptures. The postoperative scar is hard to visualize.

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