Outcome of AO Type C Fractures Distal Radius treated with Volar Locking Plates in a Tertiary care center Lahore

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ABSTRACT

Objective: To determine the clinical and radiological outcome of AO Type C fracture distal radius treated with 2.4mm Titanium volar locking plates.

Methods: This descriptive study was conducted in Department of Hand and Upper limb Surgery(HULS) Combined Military Hospital(CMH) Lahore Pakistan from 23rd January 2016 to 4th January 2019.All adults patients of either gender with distal radius fractures(Type C) fulfilling the inclusion criteria were treated with 2.4mm volar locking plates. Post operative flexion and extension of the wrist was measured with goniometer and grip strength with a weighing scale. Radiological outcome was determined by comparing pre operative and post operative radial height, radial inclination and volar tilt. *P* value was calculated for net improvement of radiological outcome and < 0.05 was considered significant.

Results: The total number of patients in our study were 52.Mean age of the patients were 40.26 ± 12.7 years(range 18 to 69 years).Male patients were 39(75%) and female 13(25%).Right radius was fractured in 28(53.8%) patients and left in 24(46.1%).AO type C2 fracture was noted in 24(46.1%),C1 in 19(36.5%) and C3 in 9(17.3%) patients. Post operative mean wrist flexion was 78°±7 (range 62° to 80°) and extension 68°±4 (range 60° to 75°)at last follow up. The grip strength was excellent in 22(42.3%), good in 18(34.6%) and average in 12(23%).The mean value of pre operative Radial Height(RH) was improved from5.35±3.32 to 11.42±0.800, Radial Inclination(RI) from 13.83±3.71 to 21.09±0.793 degrees, and Volar Tilt(VT) from 5.43±11.9 to11.22±0.951 degrees. The net improvement in RH, RI and VT was 6.11 ± 2.77, 7.26 ± 2.89 and 15.65 ± 14.26 (P > 0.05).No major complication was documented in our study.

Conclusion: Titanium volar locking plates produced excellent functional and radiological outcome in patients with intra articular fractures of the distal radius. We therefore, recommend 2.4mm Titanium volar locking plate as implant of choice to treat Type C fractures.

Keywords: AO Type C fracture, Distal Radius, Internal Fixation, Locking plate, Radial Height, Radial Inclination, Volar Tilt.

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INTRODUCTION

Distal radius fracture is one of the commonest adult fractures and the the incidence varies from 5.7 to 124.6 per 10,000 persons.[1] Variable functional outcome has been reported when these fractures are treated non operatively.[2] In younger adults displaced fractures usually require operative intervention,[3] but the decision to operate on an undisplaced fractures is not always easy.[4-8] Some conservatively treated fractures have been found displaced in plaster later on and ultimately requiring surgery.[9,10] Anatomical and stable fracture reduction is achieved through internal fixation which allows early wrist and hand mobility and prevents stiffness.[11-13]

Open reduction and internal fixation of distal radius fractures can be achieved through

conventional buttress plate and dynamic compression plates with or without k wires.[14] However in recent times volar locking plate has gained popularity as the implant of choice to treat all distal radius fractures particularly in patients with osteoporotic fractures.[15] Although costly, more than 30 types of volar locking plates have been designed to treat distal radius fractures.[16] Fixation with titanium volar locking plates.(2.4mm) has shown excellent outcome in distal radius fractures.[17]

Previously we used to fix all distal radius fractures with T buttress plates including Type C fractures(intra articular). Our results were not good particularly in Type C fractures because we were unable to hold comminuted fracture fragments firmly with buttress plate. As a result fracture displacement and delayed mobilization would result in pain, stiffness and osteoarthritis of the wrist joint. The objective of our study was to determine the clinical and radiological outcome of AO Type C fracture distal radius treated with 2.4mm Titanium volar locking plates. We hope that the results of our study would help us in formulating standard and uniform guidelines to treat Type C fractures of the distal radius in our institution.

METHODS

We conducted this descriptive study in Department of Hand and Upper limb Surgery(HULS) Combined Military Hospital(CMH) Lahore Pakistan from 23rd January 2016 to 4th January 2019.All adults patients of either gender with intra articular distal radius fractures(Type C) presented within a week to our hospital were enrolled in our study. Patients with bilateral radius fractures, open fractures, ulna fracture and poly trauma patients requiring surgical intervention for other injuries were excluded from our study. The study protocols were approved by the Ethical Review Board(ERB) of the hospital. Informed written consent was taken from all the patients. In the included patients radiographs of the wrist in AP and lateral projections were taken and pre operative Radial Height(normal 10 to 13mm),Radial Inclination(21 to 25 degrees) and Volar Tilt(7 to 15 degrees) were calculated according to a standard technique of Kreder.[18] A 3D CT scan was done and exact fracture configuration was noted in each case.

Surgical Technique

All surgeries were performed under regional or general anaesthesia and tourniquet control.Pre operative antibiotics(Injection Cefuroxime 1.2 gm intravenous) was administered to all the patients before tourniquet inflation. Through volar forearm approach fracture was exposed reduced, provisionally hold with K wires and fixed with an appropriate 2.4 mm Titanium locking plate.(Fig.IA-ID)Image intensifier was utilized per operatively for confirming fracture reduction and avoiding of screw penetration into the wrist joint. The wound was closed and back slab applied for two weeks.

Post op radiographs were advised next day and radiological parameters(RH,RI and VT) were determined. Patients were advised follow up at 2 weeks,6 weeks,8 weeks initially and then monthly for 9 months.Radiological outcome(RH,RI,VT) at the last follow up visit was measured as per Kreder technique.[18] Post operative flexion and extension of the wrist was measured with goniometer. Grip strength was measured with the help of a weighing scale as advised by Reynolds[19] and graded as excellent, good, average, below average and poor.[20]

The data was analysed with SPSS version 23. Frequency and percentages were calculated for qualitative variables while mean and standard deviation for quantitative variables. *P* value was calculated for net improvement of radiological outcome and < 0.05 was considered significant.Data presented in tables where necessary.

RESULTS

Our study included 52 patients with mean age 40.26 ± 12.7 years(range 18 to 69 years).Most of the patients were male (75%, n=39) while female were 13(25%).The predominant side of fracture was right(53.8%,n=28).Left radius was fractured in 24(46.1%) patients. The aetiology of fracture was motor vehicle accidents in 42(80.7%) patients and fall in 10(19.2%) patients. Majority(46.1%,n=24) of the fractures were AO type C2 followed by AO C1(36.5%,n=19) and AO C3(17.3%,n=9).Our minimum follow up was 9 months(range 9 to 13 months).All the fractures ultimately united with an average radiological union time of 3.2±5 months(range 2.6 months to 4.9 months) At last follow up visit post operative mean wrist flexion was 78°±7 (range 62° to 80°) and extension 68°±4 (range 60° to 75°). The grip strength was excellent in 22(42.3%), good in 18(34.6%) and average in 12(23%). No below average and poor grip strength was noted. The radiological parameters(RH, RI,VT) as measured with X-ray AP and lateral view preoperatively, immediate post operatively and at 9 months is shown in table I. The net improvement in RH, RI and VT was 6.11 ± 2.77, 7.26 ± 2.89 and 15.65 ± 14.26 ($P > 0.05$).No significant association

was noted between the specific type C(C1,C2,C3) fracture and functional or radiological outcome. Tourniquet palsy was noted in 2(3.8%) cases and superficial skin infection in 3(5.7%) patients but all recovered with conservative treatment. No major complication was noted.

Fig. IA-IB: Pre operative radiograph of AO type C fracture distal radius.

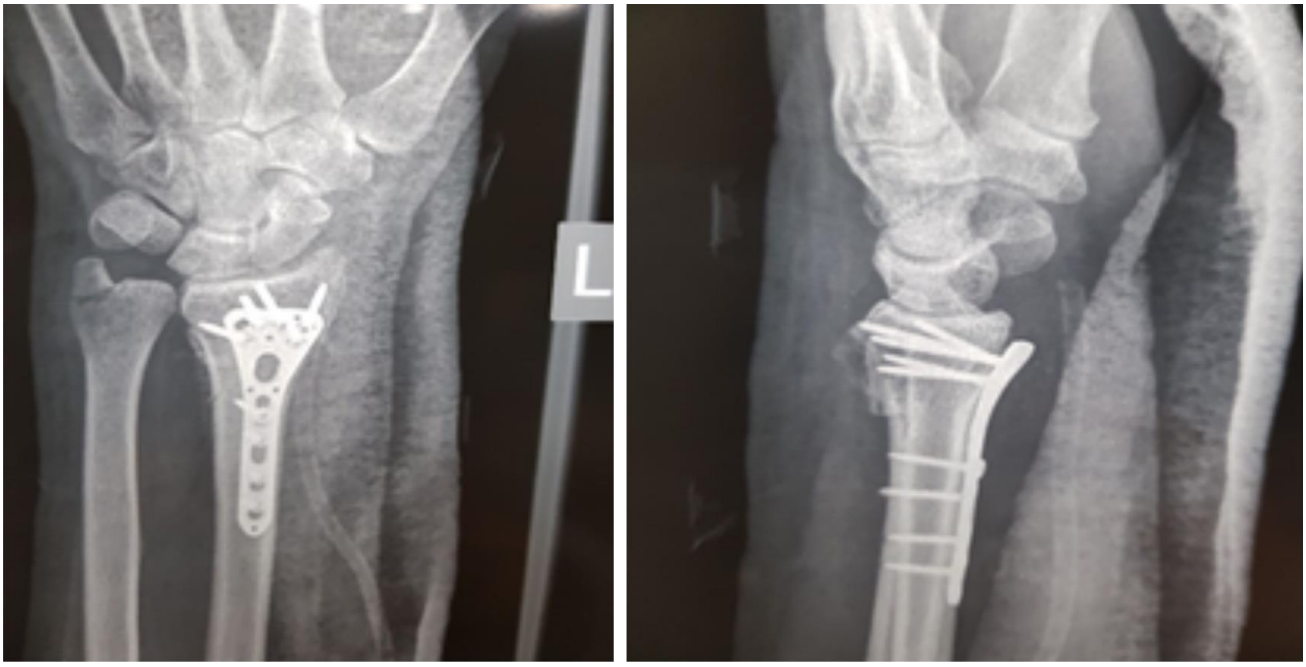

Fig. IC-ID: Post operative radiograph after fixation with Titanium volar locking plate.

Table I: Radiological parameters of distal radius fractures.

Time of Radiographs	RH(SD)mm	RI(SD) degree	VT(SD) degree
Pre-op	5.35±3.32	13.83±3.71	-5.43±11.9
Immediate Post-operative	11.54±0.63	21.22±0.736	11.30±0.822
Last Follow up Visit	11.42±0.800	21.0±0.793	11.22±0.951

DISCUSSION

Over the last few years most fractures of the distal radius are treated conservatively than operatively because no consensus has been achieved regarding the ideal implant of fixation.[10,11]Various modalities of fixation are external fixator, volar or dorsal locking plates, and k wires.[21,22] Each method has merits and demerits. Pin tract infection is common with external fixator while loss of reduction is associated with K wires.[23,24] Although dorsal commination is best addressed with a dorsal locking plate, tendon rupture has been reported with dorsal locking plate.[25,26] Use of volar locking plates have gained popularity because of lesser complications and excellent outcome in most cases, some authors reported equivocal results of volar versus dorsal locking plates.[22-24] Volar locking plate can hold all the fragments of Type C fracture(intra articular) anatomically reduced and early mobilization can be initiated without fear of loss of reduction or implant failure.[27,28]

We treated 52 patients of distal radius fracture(AO type C) with volar locking plates.The average value of pre operative Radial Height(RH) was improved from5.35±3.32 to 11.42±0.800, Radial Inclination(RI) from 13.83±3.71 to 21.09±0.793 degrees, and Volar Tilt(VT) from 5.43±11.9 to11.22±0.951 degrees at 9 months follow up.Khan[29] treated 43 intra articular distal radius fractures with locking plates and immediate post operative radiographs showed radial height 10.2±1.95 mm, radial inclination 17.26±3.23 degrees and volar tilt 7.67±4.28 degrees. At last follow up radial height was 9.8±1.8mm,radial inclination 17±3.8 degrees and volar tilt 7.6±4.2 degrees. He assessed functional outcome with Quick Dash score and at 6 months very good outcome was noted in 1(2.2%) patient, good in 30(66.7%),satisfactory in 10(22.2%) and poor in 4(8.9%) patients. Osad and Kamei[30] treated 49 patients of distal radius fractures with locking plates and at one year follow up noted radial inclination of 22 degrees and volar tilt of 9 degrees. The functional score was 100% and 98% as assessed with Gartland and Werley system and modified Green and O'Brien system respectively. The Disabilities of the Arm, shoulder and Hand score was 6. They reported no wound infection, nerve injury and implant failure.

We did not noted any loss of reduction in our series while Earp and colleague[31] reported that although majority(89.6%,n=69) of AO C3 fractures healed with locking plates, loss of reduction was noted in 8(10.4%) patients. Gurber[32] treated 55 distal radius fractures(C2 and C3) with volar locking plates and reported loss of volar tilt of 1.9±3.3 degrees and loss of radial inclination of 1.4±2.8 degrees at 29±7 months follow up. This loss of volar tilt and radial inclination was statistically significant(P <0.001) while radial shortening was not significant.(P> 0.05).Our follow up period was short and longer follow up is needed to see for any possible loss of reduction.

We assessed the post operative functional outcome of our patients by measuring wrist flexion, extension and grip strength. We documented that mean wrist flexion was 78°±7 (range 62° to 80°) and extension 68°±4 (range 60° to 75°) while grip strength was excellent in 22(42.3%), good in 18(34.6%) and average in 12(23%). No below average and poor grip strength was noted. Grip strength is usually measured with the help of dynamometer but due to the non availability of this device we measured the grip strength with the help of a weighing scale as advised by Reynolds.[19]In literature various functional scoring systems have been used for assessing the functional outcome. Fowler[33] treated 37 patients with volar locking plate and at one year follow up radiographs revealed 3 degree volar tilt, radial height 12 mm and radial inclination 21 degrees. Functional outcome as assessed with Disabilities of the Arm, Shoulder and Hand Score was 6 and mean VAS(Visual Analog Score) was 0.3.The grip strength of the operated side was 96% compared to the non operative side.

We treated all Type C fracture through volar approach and achieved excellent radiological and functional outcome. Rein and colleague[34] treated 29 AO C3 fractures with either volar locking plates(n=15) or dorsal locking plate(n=14). Both groups had good to very good radiological outcome. Although functional outcome was satisfactory in both groups, volar locking plates had better functional outcome than dorsal group but statistically non significant.

We have not noted any per operative or post operative major complication. However tourniquet palsy was documented in 2(3.8%) cases and superficial skin infection in 3(5.7%) patients but all recovered with conservative treatment. Li Y and Zhou Y[35] treated with 1175 fractures in 1152 patients with volar locking plate and noted carpal tunnel syndrome in 31(2.6%), loss of reduction in 23(2%) and wound infection in 18(1.5%).

The limitations of our study are descriptive design, small sample size and short follow up period.We therefore recommend further randomized controlled studies with larger sample size and longer follow up period to confirm our results.

CONCLUSION

Titanium volar locking plates produced excellent functional and radiological outcome in patients with intra articular fractures of the distal radius. We therefore, recommend 2.4mm Titanium volar locking plate as implant of choice to treat Type C fractures of the distal radius.

Conflict of Interests: None
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