

## Research Article

# Volar Barton Fracture Treatment with T Plate Using Distal End Screws and Without Distal End Screws; A Comparative Study

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### Abstract

**Background:** Volar Barton's fractures are the fracture of distal radius with intra-articular extension associated with dislocation and subluxation of radiocarpal joint requiring surgical treatment with volar plate to achieve anatomical reduction.

**Objective:** To compare Volar Barton's fracture treatment deploying T-buttress plate with and without distal end screws in terms of pain, activities, grip strength and functional outcome of hand and wrist.

**Methods:** The patients were divided in two groups by using opaque sealed envelope method. All the findings of study variables such as age, gender, residence, height, weight, BMI, duration of fracture and functional outcome were noted in a predesigned Proforma.

**Results:** Total of 68 patients (34 in each), mean age of the group with distal end screw was calculated as  $41.44 \pm 6.01$  years and mean age of the group with distal end screw was  $44.21 \pm 5.22$  years. There were 25 males and 9 females in the group without distal end screw and 28 males and 6 females in the group with distal end screw. Green O Brein score was  $88.94 \pm 7.26$  in the group without distal end screw and  $84.08 \pm 8.09$  in the group with distal end screw. ( $p=0.011$ ) Total of 68 patients (34 in each), 67.7 % ( $n=23$ ) had excellent, 30.8 % ( $n=8$ ) good, 50.0 % ( $n=2$ ) fair and 25.0 % ( $n=1$ ) had poor functional outcome in T-plate without distal end screw group, 32.4 % ( $n=11$ ) had excellent, 69.2 % ( $n=18$ ) good, 50.0 % ( $n=2$ ) fair and 75.0 % ( $n=3$ ) had poor outcome and in T-plate with distal end screw group. ( $p=0.028$ )

**Conclusion:** It was concluded from this study results that T-plate without distal end screw group can provide excellent results in treating volar Barton's fractures.

**Received:** 14-05-2024 | **Revision:** 23-11-2024 | **Accepted:** 25-03-2025

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**Keywords** | Volar Barton fracture, T-plates, Functional outcome.

### Introduction

The most common fractures that occurred in humans are distal radius fractures<sup>1</sup> and comprises of almost 17.5% of all the fractures that

presented in accident and emergency.<sup>2</sup> Out of these 17.5% distal radius fractures approximately 60% fractures are intra-articular fractures.<sup>3</sup> Volar Barton's fractures are the fracture in coronal plane of the distal end of radius which is partially articular and requires anatomical reduction<sup>4</sup>. In 1938 the name Barton's fracture is given after an American Philadelphia orthopedic surgeon Sir John Rhea Barton.<sup>2,5,6</sup>

The Barton's fracture is the fracture of distal end of



### Production and Hosting by KEMU

<https://doi.org/10.21649/akemu.v31i1.5724>

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radius that includes the volar or dorsal rim that extend into the intraarticular region<sup>5</sup>. Barton fractures totally constitute 1.2% to 4.2% of the total distal radius fracture that presented in the department.<sup>7</sup> Volar Barton fracture is the fracture of distal end of radius which is articular fracture involving either dislocation or subluxation of radiocarpal joint.<sup>6,7,8</sup> Barton's fracture does not constitute disruption of radiocarpal ligaments however the distal fracture part maintains its contact with proximal row and this is the difference between the Barton fracture and distal Radius fractures.<sup>2</sup>

Different treatment options remain nationally and internationally in treating the Volar Barton fracture, which includes closed reduction along with immobilization with cast, external fixators, percutaneous K- wire fixation, open reduction and internal fixation with wires, open reduction and internal fixation with plates like T- buttress plate, anatomical reduction locking plate, oblique T plate, volar Ellis plate, fragment specific plate or arthroscopic internal fixation with T-Plate.<sup>2</sup>

Previous studies reported the excellent functional outcome of Volar Barton Fracture in patient treated with T-plate with distal screw was 60%<sup>9</sup> and without distal screw was 89.3%.<sup>10</sup> Another study reported that all the patients with Volar Barton fracture had good to excellent functional outcome with full extension and flexion after treated with T-plate without distal screw fixation.<sup>11</sup>

In Pakistan the treatment of volar Barton includes open reduction internal fixation using T plate, T locking plate, variable angle volar locking plate (Chinese version), T Buttress plate and Faisal Technique.<sup>3,6</sup>

In our study we aim to compare the treatment of volar Barton's fracture with T Buttress plate with and without using distal end screws in terms of pain, range of motion, activities, grip strength compared with normal side. On extensive literature search we didn't find any comparative study on this topic at international level and local level. Few separate studies showed T-plate without distal screw have better outcomes.

## Methods

This Quasi experimental study was conducted in Orthopedic Unit-I Mayo Hospital Lahore, after taking consent from Research Evaluation Unit, CPSP and ERB. A total 68 patients were included in the study. Patients with Volar Barton's fracture presented thru emergency or OPD meeting the inclusion criteria were included. After complete history, detail examination and consent patient were divided into two groups using opaque sealed envelope method. Patients in group A were managed by T-plate with distal screw while group B were managed by T-plate without distal screw. Post procedure all patients were followed till 90 days for the assessment of functional outcomes as defined in operational definition. Follow up was done according to the schedule i.e. on day 0, on 14th, 28th and 90th day. All the findings of study variables such as age, gender, residence, height, weight, BMI, duration of fracture and functional outcome were noted in a predesigned Performa.

SPSS version 26 was used to analyze the data. Percentage and frequency were reported for qualitative variables like gender, residence and functional outcome, whereas Quantitative variable such as age, BMI and duration of symptoms were reported as mean +S.D.

Chi-square test was used to compare functional outcome among both the groups, while perplexing variables like age, gender, body mass index, duration of trauma and residence were controlled by stratification. Chi-square test was applied and was taken significant after p-value  $\leq 0.05$ .

## Results

Gender distribution of the patients was done, it showed that out of 68 patients, 30.8% (n=8) good, 50.0% (n=25) fair and 19.2% (n=13) poor functional outcome. In T-plate without distal end screw group 47.2% (n=25) were males and 52.8% (n=28) were females and in T-plate with distal end screw group 47.2% (n=25) were males and 52.8% (n=28) were females.

Distribution of functional outcome was done, it showed that out of 68 patients (34 in each), 67.7% (n=23) had excellent functional outcome, 29.4% (n=10) had fair functional outcome and 2.9% (n=1) had poor functional outcome in T-plate without distal end screw group,

32.4% (n=11) had excellent, 69.2% (n=18) good, 50.0% (n=2) fair and 75.0% (n=3) had poor outcome and in T-plate with distal end screw group. (Table No. 1)

Age distribution of the patients was done, it showed that out of 68 patients (34 in each), 68.0% (n=17) were in age group of 18-40 years and 39.5% (n=17) were in age group of 41-60 years in T-plate without distal end screw group and 32.0% (n=8) were in age group of 18-40 years and 60.5% (n=26) were in age group of 41-60 years in the group with distal end screw, mean age of the group without distal end screw was calculated as  $41.44 \pm 6.01$  years and mean age of the group with distal end screw was  $44.21 \pm 5.22$  years. (p=0.043) (Table No. 2)

Distribution of BMI was  $26.19 \pm 3.69$  kg/m<sup>2</sup> in the group without distal end screw and  $25.46 \pm 3.54$  kg/m<sup>2</sup> in the group with distal end screw. (p=0.413) (Table No.3)

Distribution of Green O Brein score was  $88.94 \pm 7.26$  in the group without distal end screw and  $84.08 \pm 8.09$  in the group with distal end screw. (p=0.011) (Table No.4)

Both groups were compared for functional outcome and showed significant results. (p=0.028) Table No.5) Figure-1.

Mean $\pm$ SD (T-plate without distal end screw group) =  $41.44 \pm 6.01$  years Mean $\pm$ SD (T-plate with distal end screw group) =  $44.21 \pm 5.22$  years.

**Table 1:** Distribution of functional outcome N= 68

Functional outcome	Groups		Total
	Without distal end screw group	With distal end screw group	
Excellent	23 (67.7%)	11 (32.4%)	34 (100.0%)
Good	8 (30.8%)	18 (69.2%)	26 (100.0%)
Fair	2 (50.0%)	2 (50.0%)	4 (100.0%)
Poor	1 (25.0%)	3 (75.0%)	4 (100.0%)
Total	34 (50.0%)	34 (50.0%)	68 (100.0%)

**Table 2:** Distribution of age N= 68

Age group	Groups		Total	p value
	Without distal end screw group	With distal end screw group		
18-40 years	17 (68.0%)	8 (32.0%)	25 (100.0%)	0.043
41-60 years	17 (39.5%)	26 (60.5%)	43 (100.0%)	
Total	34 (50.0%)	34 (50.0%)	68 (100.0%)	

**Table 3:** Distribution of BMI N= 68

variable	Without distal end screw group	With distal end screw group	p value
	mean $\pm$ SD	mean $\pm$ SD	
BMI (kg/m <sup>2</sup> )	$26.19 \pm 3.69$ kg/m <sup>2</sup>	$25.46 \pm 3.54$ kg/m <sup>2</sup>	0.413

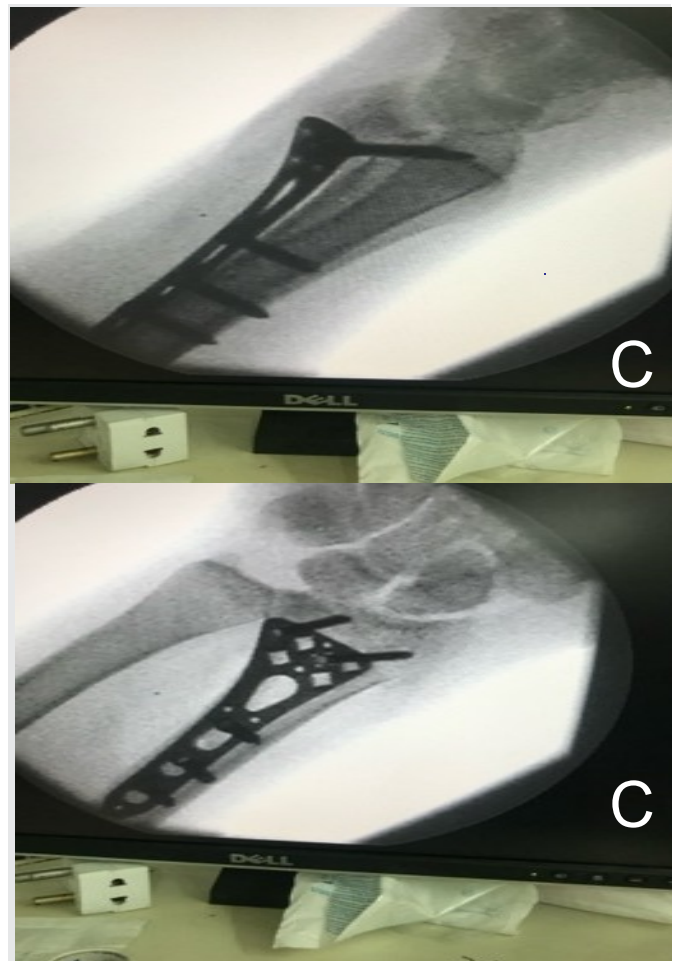
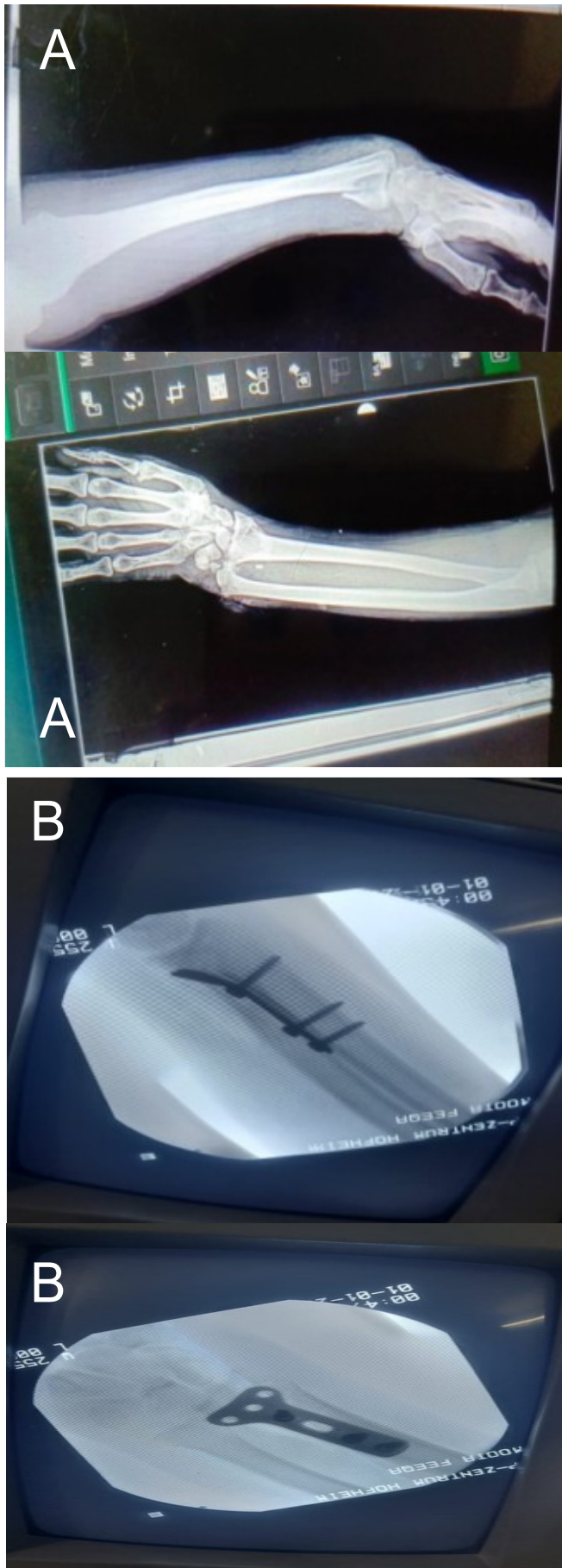
**Table 4:** Distribution of GREEN O BREIN SCORE N= 68

Variable	Without distal end screw group	With distal end screw group	p value
	mean $\pm$ SD	mean $\pm$ SD	
GREEN O BREIN SCORE	$88.94 \pm 7.26$	$84.08 \pm 8.09$	0.011

**Table 5:** Comparison of both groups for functional outcome using chi-square test N= 68

Functional outcome	Groups		Total	p value
	Without distal end screw group	With distal end screw group		
Excellent	23 (67.7%)	11 (32.4%)	34 (100.0%)	0.028
Good	8 (30.8%)	18 (69.2%)	26 (100.0%)	
Poor	2 (50.0%)	2 (50.0%)	4 (100.0%)	
Fair	1 (25.0%)	3 (75.0%)	4 (100.0%)	
Total	34 (50.0%)	34 (50.0%)	68 (100.0%)	





**Figure-1:** (A,B,C) : 1A (Volar Barton Fracture), 1B(Plate without distal end screws), 1C (Plate with distal end screws)

### Discussion

The name Barton fracture is given after the American Philadelphia orthopedic surgeon John Rhea Barton which includes the fracture of distal end of radius extending intraarticularly along with volar or dorsal rim of radius. Numerous studies have shown excellent result by surgical treatment.<sup>12</sup> Fixation with plate provides anatomical reduction, stable fixation and early wrist function avoiding long immobilization.<sup>13</sup> In intra-articular fractures, Buttress plates minimize and stabilize the vertical shear due to its antiglide effect, however the locking plates are used for metaphyseal comminution and/or preserve articular reduction/congruity.<sup>13</sup> In case where locking plates are used the intraarticular fracture is directly and manually reduced while in case of buttress plates, the intra-articular fracture is reduced by its opposing force. One of the complications is tendon irritation or

rupture that requires its removal.<sup>14</sup> Best short term and long-term results were achieved by restoring the distal radial anatomy.<sup>15</sup> The guidelines for acceptable reduction include radial shortening of less than 5 mm, radial inclination of more than 15°, sagittal tilt on lateral projection between 15° dorsal and 20° volar tilt, articular incongruity of less than 2 mm of the sigmoid notch of distal radius and intra-articular step-off less than 2 mm of the radiocarpal joint. Literature showed different success rates either surgical or non-surgical yet surgical treatment is currently favored.<sup>16</sup>

In current study, treatment of volar Barton's fracture with T plate using distal end screws and without using distal end screws are compared in terms of functional outcomes of wrist and hand. Total of 68 patients (34 in each group), 68.0% (n=17) were in age group of 18-40 years and 39.5% (n=17) were in age group of 41-60 years in T-plate without distal end screw group and 32.0% (n=8) were in age group of 18-40 years and 60.5% (n=26) were in age group of 41-60 years in the group with distal end screw, mean age of the group without distal end screw was calculated as  $41.44 \pm 6.01$  years and mean age of the group with distal end screw was  $44.21 \pm 5.22$  years. ( $p=0.043$ ). There were 47.2% (n=25) male and 60.0% (n=9) females in the group without distal end screw and 52.8% (n=28) male and 40.0% (n=6) were females in the group with distal end screw. ( $p=0.560$ ). BMI was  $26.19 \pm 3.69$  kg/m<sup>2</sup> in the group without distal end screw and  $25.46 \pm 3.54$  kg/m<sup>2</sup> in the group with distal end screw group. ( $p=0.413$ ). Green O Brein score was  $88.94 \pm 7.26$  in the group without distal end screw and  $84.08 \pm 8.09$  in the group with distal end screw ( $p=0.011$ ). Out of 68 patients (34 in each group), 67.7% (n=23) had excellent, 30.8% (n=8) good, 50.0% (n=2) fair and 25.0% (n=1) had poor functional outcome in T-plate without distal end screw group, 32.4% (n=11) had excellent, 69.2% (n=18) good, 50.0% (n=2) fair and 75.0% (n=3) had poor outcome and in T-plate with distal end screw group. ( $p=0.028$ )

In 2019 Ali et al. published a study in which they showed that all the patients (43/43) with volar Barton fractures were reduced and fixed anatomically and they showed union rates of 100%.<sup>6</sup> Even the cancellous bone did not delay the healing process and hence the success rate was high. In their long term follow up only 5 out of 43 patients showed fair results

as the patients had slight restriction of range of motion due to slight finger contraction. These results were almost similar with a study conducted in 2000 by Kapoor and co-workers who concluded in their study that open reduction and internal fixation with plate yields best articular congruity in comminuted distal radius fractures with high chances of union rates.<sup>17</sup>

In 2015 Sahito et al. conducted a study of 45 patients with volar Barton fractures in their study there were 73% male and 27% females, and their age ranged from 20-50 years. Mode of trauma included 38% with history of fall while 62% with RTA. They treated 16% (07) patients with locking plates while remaining with buttress plate. They assessed the functional outcome on the basis of modified Green and O'Brien scoring and showed excellent result in 44% (20) patients, good in 36%<sup>16</sup>, fair in 16%,<sup>7</sup> whereas poor in only 4%<sup>2</sup> patients. Moreover, with 9 months follow-up union was seen in all the patients and was achieved in 8 to 12 weeks.<sup>18</sup>

Islam MA, Kumar N et al in 2022 published that Volar Barton's fracture of the distal radius is relatively very unstable in nature and difficult to treat with a conservative method of treatment. However, they concluded that the functional outcome of a Volar Barton's fracture of distal radius treated with a buttress plate is highly satisfactory and statistically significant which was similar to our study using buttress method.<sup>19</sup>

Various studies have shown good functional results and good satisfaction rates of volar plating.<sup>20,21,22,23</sup> In this study, 68 patients with volar Barton's fracture (34 in each), 67.7% (n=23) had excellent, 30.8% (n=8) good, 50.0% (n=2) fair and 25.0% (n=1) had poor functional outcome in T-plate without distal end screw group, 32.4% (n=11) had excellent, 69.2% (n=18) good, 50.0% (n=2) fair and 75.0% (n=3) had poor outcome and in the group with distal end screw. ( $p=0.028$ ).

## Conclusion

In current study, we compared treatment of volar Barton's fracture with T plate using distal end screws and without using distal end screws in terms of functional outcomes of wrist and hand. Total of 68

patients (34 in each), 67.7 %(n=23) had excellent, 30.8 %(n=8) good, 50.0 %(n=2) fair and 25.0 %(n=1) had poor functional outcome in T-plate without distal end screw group, 32.4 %(n=11) had excellent, 69.2 %(n=18) good, 50.0 %(n=2) fair and 75.0 %(n=3) had poor outcome and in the group with distal end screw. (p=0.028). By these considerations, the group without distal end screw provides excellent results in treating volar Barton's fractures.

**Ethical Approval:** The Research Evaluation Unit, CPSP approved this study vide RefNo. CPSP/REU/OSG-2021-066-2575.

**Conflict of Interest:** The authors declare no conflict of interest.

**Funding Source:** None

#### Author Contribution

**MA:** Conception & design, drafting of article, critically revised it for important intellectual content, final approval of the version to be published

**MS:** Conception & design, acquisition of data, drafting of article

**FMF:** Analysis & interpretation of data

**WA:** Drafting of article

**MKN:** Analysis & interpretation of data

**AH:** Analysis & interpretation of data

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