

## Original Research Article

# Impact of triangular fibrocartilage complex injury in distal radius fracture on functional outcome

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## ABSTRACT

**Background:** There is limited clinical data suggesting whether triangular fibrocartilage complex (TFCC) injury, associated with distal radius fracture (DRF), should be diagnosed and treated regularly. This study was conducted to identify the incidence of TFCC injury in DRF and its effects on outcome after fracture healing.

**Methods:** This was a prospective cohort study wherein patients treated for DRF were evaluated for TFCC injury. Data collected at 3 and 6 month follow up included grip strength, range of movement and Patient Rated Wrist Evaluation (PRWE) score. Data from 24 patients with TFCC injury and 26 patients without TFCC injury was analyzed.

**Results:** Out of the total 50 patients with DRF, 48% were diagnosed with TFCC injury using wrist arthrography. Most (58.33%) of which were associated with fractures due to road traffic accidents. A significantly higher proportion of patients reported pain on ulnar deviation ( $p=0.035$ ) and positive press test ( $p<0.001$ ) in those with compared to without TFCC injury. The mean PRWE score in those with and without TFCC injury were  $27.92\pm 17.61$  and  $21.15\pm 12.79$  respectively. An associated ulnar styloid fracture was observed in ~46% patients. There was no statistically significant difference in the outcome measures between the two groups.

**Conclusions:** In our study, the incidence of TFCC injury in DRF was 48%. There was no significant effect of TFCC injury on the functional outcome of wrist after DRF healing. We thereby conclude that routine diagnosis and treatment of TFCC injury in DRF is not essential.

**Keywords:** Conservative management, Radius distal fractures, Triangular fibrocartilage complex, Wrist injury

## INTRODUCTION

Distal radius fractures (DRF) are among the most commonly encountered fractures in clinical practice, with an incidence of 220/lakh population and accounting for nearly 18% of all fractures in the elderly.<sup>1,2</sup> Appropriate management of these fractures is imperative, as any deviation from normal could result in decreased grip strength and diminished movements of the wrist and hand joints, thereby affecting an individual's routine activities.<sup>3</sup>

Patients with DRF typically present with pain, inflammation and deformity of the hand in either direction depending on the force causing the fracture.<sup>4</sup> Furthermore, the fracture may get complicated by injury to juxtaposed nerves, blood vessels, soft tissues and ligaments such as the triangular fibrocartilage complex (TFCC), scapholunate ligament, and lunotriquetral ligament.<sup>5</sup> The TFCC acts as a pivot point and plays a significant role in stabilization, rotation, translation and load transmission of the wrist joint.<sup>6,7</sup> A distal radioulnar joint (DRUJ)

instability or TFCC lesion may lead to chronic pain during powerful rotational hand movements, and can have ulnar-sided pain while lifting heavy objects.<sup>8</sup> This could also result in a prominent ulnar head or swelling along the prestyloid recess or the ECU tendon sheath; grip strength might be affected.<sup>9</sup>

Though several modalities are used for the diagnosis and treatment of intra-articular ligament injuries, i.e., arthrography, magnetic resonance (MR) arthrography, MR imaging (MRI) without preceding arthrography, computed tomographic (CT) arthrography, arthroscopy, and sonoarthrography with high frequency linear transducers, arthroscopy is considered as a standard for such injuries in the wrist. Nevertheless, it is limited by a lack of skilled surgeons in public hospitals, limited access to modern instruments and higher cost. While MR arthrography is known for high sensitivity and specificity for diagnosing injuries in wrist ligaments, it has drawbacks of high cost, unavailability, inter-observer variability, and feasibility before surgery.<sup>10</sup> On the other hand, arthrography is comparatively cheap, widely available, safe, and can be done quickly just prior to the fracture fixation procedure under C-arm fluoroscopy.<sup>11</sup>

Previous studies have reported a highly varied incidence of TFCC injuries in DRF ranging from 17% to 96%.<sup>12-15</sup> However, there is a paucity of clinical studies that evaluate the effect of TFCC injuries on the outcome of healed DRF. The present study was, hence, conducted to assess the incidence of TFCC injury associated with fracture of the lower end of the radius using arthrography, and compare the functional outcome of DRF in patients with and without TFCC injury.

## METHODS

The prospective COHORT study was conducted at a tertiary care center in Western India. This prospective cohort study was conducted at K. J. Somaiya Medical College and Research Centre, Sion, Mumbai, India, from September 2018 to October 2020. The study was initiated after obtaining ethics committee approval from the institution. All patients with acute DRF presenting to the casualty and outpatient departments were considered. All patients with radiographic evidence showing DRF, planned for operative reduction and management, and providing written informed consent were included in the study. Patients were excluded if they were aged <20 years, had any congenital abnormality of the upper limb, history of any previous trauma/fracture or surgery of the same wrist, open fracture, known degenerative disease of the wrist, history of wrist pain before present trauma, associate carpal bone fracture, and malunited fractures.

Posteroanterior and lateral radiographs of the wrist were taken at 2 weeks, 6 weeks postoperatively and at 3 months. The Frykman classification was used to classify the type of fractures. Presence of ulnar styloid fracture was noted. For diagnosis of TFCC injury, wrist arthrography was

done before any surgical procedure. Patients were treated with initial immobilization with plaster of Paris slab for all injuries, with strict limb elevation. Analgesics and anti-inflammatory drugs were given to relieve pain and reduce associated soft tissue edema. In all patients who were taken up for casting or surgery, closed fracture reduction was done under fluoroscopy.

Patients were followed up for a period of 3 months in the outpatient department. Radiographic evaluation included assessment of any articular incongruity, as demonstrated by any articular step or gap, radial inclination, volar or dorsal tilt, and radial length. The DRUJ was assessed with regard to the congruity of the joint. Functional outcome was assessed at 3 months after surgery; evaluations included range of wrist and forearm movement (using a goniometer and compared with the contralateral wrist), pain on ulnar deviation, press test to provoke ulnar wrist pain, and grip strength (using a dynamometer and compared with the contralateral wrist). Subjective outcome was evaluated using the patient rated wrist evaluation (PRWE) scale questionnaire at the last visit.

The sample size for this study was calculated using the formula for quantitative data with cross sectional study design.

$$\text{Sample size} = \frac{4pq}{L^2},$$

where,

4=z value at 5% level of significance,

p=50% (proportion of TFCC injury),

q=100-p=50%,

L=15% (allowable error),

the estimated sample size was 45.<sup>14,16</sup> Assuming 10% nonresponse rate the corrected sample size was 45+4=49≈50.

## Statistical analysis

The data was analyzed using SPSS Version 25.0.(IBM Corp. Armonk, NY: IBM Corp.). Numeric continuous data was expressed as mean±standard deviation (SD). The unpaired t test was used to compare parametric data (mean age and PRWE scores) between the two groups (TFCC injured and TFCC not injured). Non-parametric test (chi square) was used to evaluate the association between range of movement, ulnar styloid fracture, pain on ulnar deviation, press test, and grip strength and occurrence of TFCC injury in patients with DRF. Statistical significance was set at p value ≤0.05.

## RESULTS

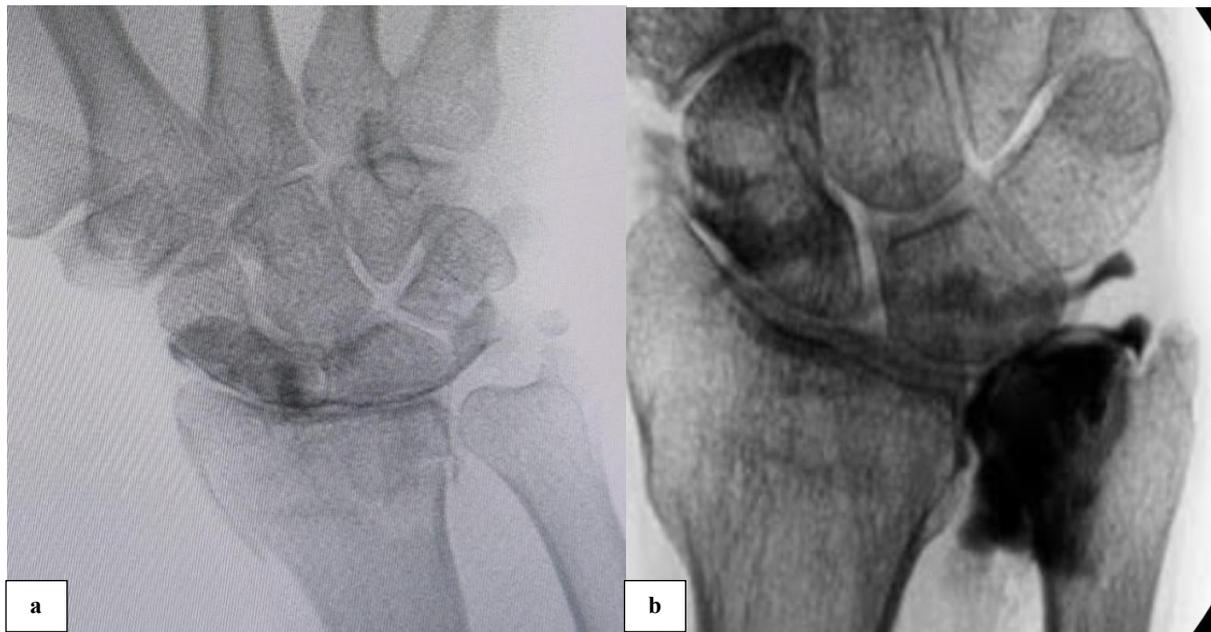
A total of 50 patients with DRF were included in this study. The mean±SD age of our patients was 44.14±9.73

years (range, 21-58), and most patients (72%) were between 40 and 59 years of age. DRF was more commonly noted in males (52%). The dominant hand was most affected (56%). The causes of DRF were fall on an

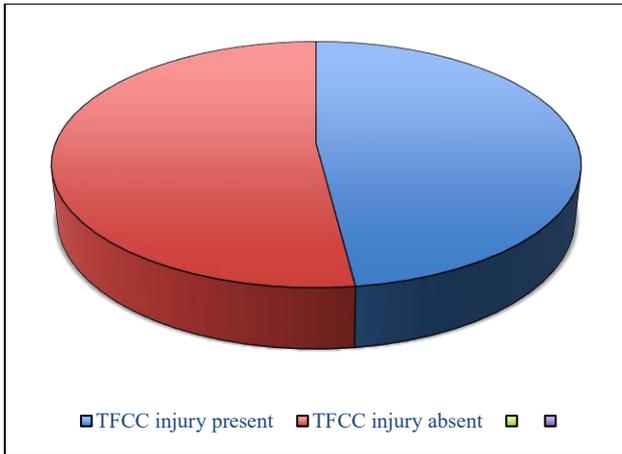
outstretched hand from standing height (FOSH; 58%), road traffic accidents (RTA; 28%) and fall from height (14%). Amongst these, TFCC injury was diagnosed in 24/50 (48%) patients using wrist arthrography (Figure 1).

**Table 1: Comparison of functional outcomes in patients with and without TFCC injury.**

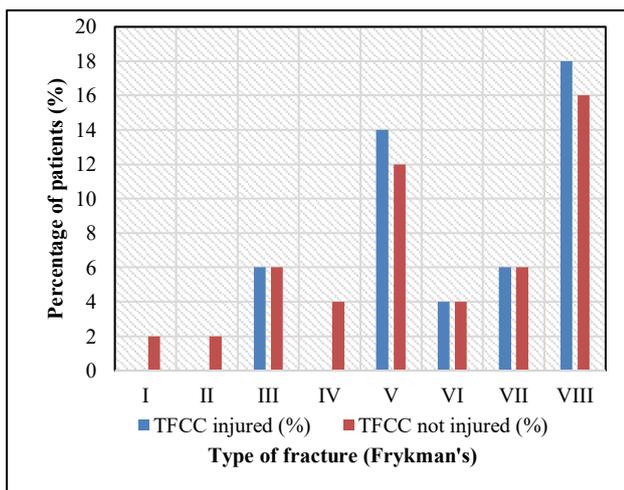
Tests	TFCC injured n (%)	TFCC not injured n (%)	P value*
	N (%)	N (%)	
<b>Pain on ulnar deviation</b>			
Present	19 (79.2)	12 (46.2)	0.035
Absent	05 (20.8)	14 (53.8)	
<b>Press test</b>			
Positive	20 (83.33)	06 (23.07)	<0.001
Negative	04 (16.66)	20 (76.93)	
<b>Grip strength</b>			
<50	02 (8.33)	05 (19.23)	0.54
50-70	14 (58.33)	13 (50)	
>70	08 (33.33)	08 (30.77)	
<b>Dorsiflexion</b>			
<50	10 (41.66)	13 (50)	0.76
≥50	14 (58.33)	13 (50)	
<b>Palmar flexion</b>			
<50	11 (45.83)	13 (50)	0.99
≥50	13 (54.16)	13 (50)	
<b>Supination</b>			
<50	10 (41.66)	14 (53.84)	0.56
≥50	14 (58.33)	12 (46.15)	
<b>Pronation</b>			
<50	08 (33.33)	14 (53.84)	0.24
≥50	16 (66.66)	12 (46.15)	



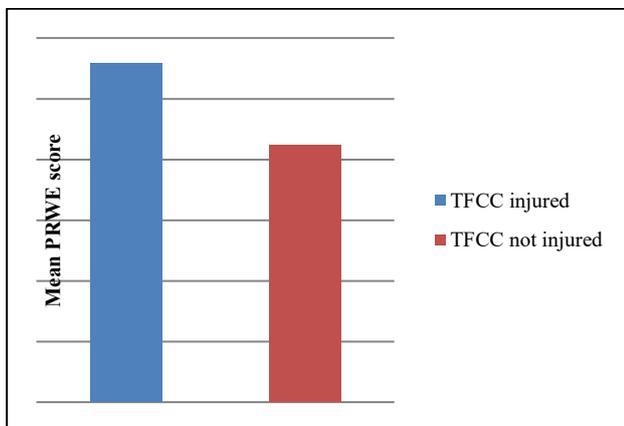
**Figure 1: Wrist arthrography showing posteroanterior view under fluoroscopy showing (a) spill of dye between radiocarpal joint and distal radioulnar joint depicting tear in Triangular Fibrocartilage complex (TFCC) and (b) no spill in intact TFCC.**



**Figure 2: TFCC injury.**



**Figure 3: Distribution of patients according to the type of fracture.**



**Figure 4: Mean PRWE scores in patients with and without TFCC injury.**

There was no significant difference between the mean age and age groups of those with TFCC injury and those without TFCC injury. Most TFCC injuries (58.33%) were associated with fractures due to RTAs. The distribution of

patients according to the type of fracture (Frykman's classification) is shown in Figure 2.

Of the patients with TFCC injury, 45.83% patients had an associated ulnar styloid fracture, with no significant association between the occurrence of TFCC injury and ulnar styloid fracture. Table 1 compares the functional outcomes in patients with and without TFCC injury.

Although the mean PRWE score was numerically higher in patients with TFCC injury (27.92±17.61) compared to those without TFCC injury (21.15±12.79), the difference was not statistically significant (p=0.12) (Figure 3).

**DISCUSSION**

The advantages of early diagnosis and treatment of TFCC injury in DRF remains controversial. In this study, 50 DRF patients were treated with different surgical methods with acceptable reduction and followed after proper radiological healing to investigate the effect of untreated TFCC injury associated with DRF on functional outcome in terms of grip strength, range of movement and subjective outcome with PRWE questionnaire. Literature search revealed a number of studies that have followed up patients with TFCC injury in DRF Lamraski et al diagnosed 57% DRF patients with ligament injury using arthrography.<sup>17</sup> Mrkonjic et al identified 51 patients of TFCC injury with DRF.<sup>18</sup> In the study by Deniz et al out of the 47 patients diagnosed with DRF, 51% were identified with TFCC injury.<sup>19</sup> Swart et al analyzed the effect of TFCC injury in 42 operatively treated DRFs in terms of DASH score, VAS pain rating, range of movement, and grip strength.<sup>14</sup> Fok et al identified 43 DRF patients, of which 41 had TFCC injuries.<sup>20</sup>

In the present study, though not statistically significant, DRF was more commonly noted in males; most fractures were due to fall on an outstretched hand, and dominant hands were more affected. Associated TFCC injury was found in almost 50% patients with DRF; although most of these injuries were intraarticular, they were not significantly associated with an ulnar styloid fracture. At the six months follow-up, the positive press test was detected in a majority of the patients with TFCC injury. Despite a significant association between pain on ulnar deviation and TFCC injury, there was no effect on grip strength. Furthermore, TFCC injury did not affect the functional outcome such as range of wrist movement and subjective outcome measured by the PRWE score.

The mean age of DRF was 44.14±9.73 years, which was similar to study conducted by Espinosa- Gutiérrez et al (38.7±15.9 years) but lower than that reported by Kasapinova et al (50.01±14.39 years) and Deniz et al (55.6±12.1 years).<sup>13,19,21</sup> Our study found a slightly higher male preponderance of DRF (52%) compared with those reported by Kasapinova et al (67%) Swart et al (71%) Ogawa et al (78%) who reported a higher female preponderance.<sup>5,13,14</sup> While majority of fractures in the

present study were due to fall on an outstretched hand (58%) from a standing height, Geissler et al found road traffic accidents to be the most common mode of injury (70%).<sup>22</sup> We observed that 56% of DRFs occurred in the dominant hand as opposed to Deniz et al (62%) and Swart et al (60%) who found a preponderance for the non-dominant hand.<sup>14,19</sup>

TFCC injury was detected in 48% patients with DRF, which was similar to studies by Deniz et al and Swart et al (51% and 50% respectively).<sup>14,19</sup> However an even higher incidence of TFCC injury among DRF patients were reported by Ogawa et al (59%) Kasapinova et al (61%), and more than 95% patients by Yan et al (96%).<sup>5,13,15</sup>

Similar to our findings, Lamraski et al found that intraarticular fractures intensify ligament injury; Richards et al reported TFCC injury associated with both intraarticular (35%) and extraarticular (53%) fractures.<sup>17,24</sup> Though we detected extraarticular DRFs in 4% patients, none of them had a TFCC injury. As reported by Lamraski et al, Deniz et al, and Yan et al we found no relation between TFCC injury and fracture type.<sup>15,17,19</sup> While ulnar styloid fracture was identified in 45.83% patients with TFCC injuries there was no statistically significant association, similar to that observed by Richards et al and Yan et al.<sup>15,23</sup>

The press test is advocated as a free, useful, noninvasive clinical test in the diagnosis of TFCC tears of the wrist.<sup>24</sup> At the 6-month follow-up, a statistically significant proportion of patients with TFCC (83%) had positive press test, and pain on ulnar deviation of hand was present in a statistically significant proportion (79.2%) of patients with TFCC injury. There have been conflicting observations in previously conducted studies, where, on one hand Metz associated ulnar side wrist pain with TFCC injury, Fok concluded that TFCC injury is not related to ulnar sided wrist pain.<sup>20,25</sup> In our study, we noted a significant association between pain on ulnar deviation and TFCC injury.

In terms of functional outcomes, we found that TFCC injury had no effect on outcome after proper healing of DRF. A number of studies have reported similar results. At 1-year of follow-up, Lamraski et al concluded that functional outcome was similar in patients with or without TFCC injury.<sup>17</sup> After an average duration of follow up of 13-15 years by Mrkonjic et al only 1 patient underwent surgical treatment for chronic wrist pain and instability.<sup>18</sup> Even though there were patients without TFCC injury were not included, they reported that TFCC injury did not have an effect on functional outcome of healed DRF. Despite including conservatively treated DRF patients, Deniz et al found no significant effect of TFCC injury on functional outcome.<sup>19</sup> In line with our findings, Swart et al and Fok et al reported no significant effect of TFCC injury on outcome of DRF after healing.<sup>14,20</sup>

On the other hand, few studies suggested that TFCC injury associated with DRF causes instability of the wrist and may result in chronic pain, instability and poor functional outcomes.<sup>12,26-28</sup> Since better outcomes were achieved when these injuries were treated, they recommend the use of wrist arthroscopy for simultaneous diagnosis and treatment of TFCC injuries. However, it should be noted that none of these studies included a comparative group with TFCC injury that were left untreated. Kasapinova et al diagnosed TFCC injury arthroscopically in 64% patients with DRF.<sup>13</sup> The mean total PRWE score in patients with TFCC injury was 24 and 16 in the intact group; the mean DASH scores were 27 and 13 respectively. TFCC injured patients had poorer subjective outcomes which was statistically significant; the grip strength was also affected by TFCC injury.

In this study, we excluded patients with prior degenerative disease, anomaly or history of wrist pain, any previous trauma; however, some patients may have an existing asymptomatic TFCC pathology. Iordache et al in their study of asymptomatic patients found 22.3% with TFCC tear and 37.8% with TFCC signal abnormalities.<sup>29</sup> Hence, it cannot be assured if all TFCC tears were a result of injury during DRF.

It is worthwhile to highlight the need for future similar prospective studies, with a larger sample size and longer duration of follow-up, to assess the effect of TFCC injury on long term functional outcome and if aggressive treatment is required. Different modalities should be used for the same patient for diagnosing TFCC injury and differentiating it from degenerative conditions, to ascertain the diagnosis of traumatic tear. Moreover, patients managed with the same method of fixation should be compared for assessing effects of TFCC injury on outcomes of distal radius fracture.

There were certain limitations of our study. Firstly, the sample size was small and the duration of follow-up was short; hence, generalization of results to a larger population is difficult. Secondly, we could not differentiate between degenerative and traumatic injury of TFCC, with the method used for diagnosis; TFCC injuries diagnosed with arthrography were not confirmed with another method of investigation. Thirdly, patients were managed with different methods of fixation, as a result of which variations in outcomes may have occurred.

## CONCLUSION

In our study, the incidence of TFCC injury in DRF was 48%. Our results demonstrate that though TFCC injury is frequently seen in DRF, it does not have a significant effect on the functional and subjective outcomes after fracture healing. Investigations to diagnose TFCC injury may not be necessary at an earlier stage, and further treatment directed to TFCC injury is not justifiable. Nevertheless, it must be noted that it can be a cause of instability and pain on the ulnar side of wrist resulting in difficulty in using the

wrist in certain routine activities even after proper fracture healing.

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