

# Long Term Effects Of Covid-19 Pandemic On Management And Outcomes Of Distal Radius Fractures

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## Abstract

**Purpose:** The purpose of this study was to assess the long-term effects of conservative orthopaedic practice during Covid-19 pandemic on management and long-term outcomes.

**Methods:** Current longitudinal retrospective cohort study included patients at a single tertiary care center in India. Successive distal radius fractures of patients in pre-COVID (2018-19), COVID (2020-21) and postCOVID (2022-23) time period groups were treated and analysed. The primary outcome was the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score, and secondary outcomes included wrist range of motion, grip strength and pain. Cohort findings were compared employing Repeated-measures analysis of variance.

**Results:** In pre-COVID group 97(82.4%) patients presented within 3 days of injury which significantly declined to 48(49%) in COVID and 94(71.2%) in post-COVID group. There was a significant reduction in admissions for inpatient care ( $p < 0.05$ ). The mean QuickDASH score at 1 year follow-up was 7.2(8.6) in COVID group that was clinically better than pre-COVID [8.5(9.2)] and post-COVID [9.7 (12.4)] cohorts. The number of reoperations or secondary surgeries required were significantly lower in the COVID group [1 (1%) patient].

**Conclusions:** COVID-19 pandemic had minimal long-term effects on results of distal radius fractures as the conservative treatment approach utilised was realistic and beneficial to patients as well as to the treating surgeons. Timely corrections of arising early treatment complications through efficient virtual clinics/telemedicine kept the prevalence of major late complications minimal. Comparatively minimal complications and prompt recovery were seen in patients being operated by percutaneous Kirschner wires fixation.

**Categories:** Infectious Disease, Orthopaedics, Trauma

**Keywords:** virtual clinics, telemedicine, functional outcomes, distal radius fractures, fracture clinic, covid-19 pandemic.

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## I. Introduction

COVID-19 pandemic is the most surreal healthcare crisis of the 21st century creating worldwide havoc. It is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It initiated in December 2019 with an upsurge in Wuhan, China. It rapidly spread around the globe in early 2020. World Health Organisation (WHO) declared the disease a public health emergency of international concern in January 2020 and a pandemic in March 2020. [1] This pandemic has claimed over 7 million lives globally and is regarded as the fifth deadliest pandemic in history.

India's first COVID-19 case was diagnosed in January 2020 in Kerala state in a student of Wuhan University. [2] The Government of India ordained a countrywide lockdown in March 2020 as a preventive measure against the pandemic. In April 2021 the country was hit by the most massive wave of infection forcing several state governments to reinforce complete lockdown. To address the coronavirus disease pandemic, Indian Orthopaedic Association issued an advisory [3] for Orthopaedic practice after considering guidelines and suggestions from various health authorities across the globe. [4] Guidelines summarised out to the following points: maintain social distancing to prevent disease spread, minimising out-patient department patients by employing telemedicine and virtual clinic, avoiding unnecessary X-rays, appointments, interdepartmental referrals and follow-up visits, minimize admissions for inpatient care, use videos/ online rehabilitation tools for

patient physiotherapy, triage patients with higher tendency for non-operative management, avoid surgeries in geriatric patients, surgeons should weigh the risk to benefit ratio and availability of resources in hospital while patient triaging for surgeries and reserve operative management for intraarticular unstable fractures only.

Orthopaedics department of our hospital formulated a rapid action plan prior to COVID-19 lockdown to decrease the risk of disease spread based on patient triage guides. Wearing N-95 mask with face shield, impermeable personal protective equipment (PPE) gears, regular repetitive hand sanitisation, social distancing, keeping waiting area vacant and calling minimal necessary staff were the salient points of safe practice. After release of treatment guidelines in countries across the globe, certain studies were conducted to evaluate their impact on orthopaedic services. One of them shows a major increment in non-operative management of distal radius fractures during the pandemic. [5] Another study focussed on manipulation under anaesthesia of fractures and concluded similar results as the pre-pandemic period despite of lesser follow-up visits. [6] A recent study conducted in the United Kingdom found no significant differences in the number of injuries requiring orthopaedic interventions and secondary surgeries. [7] However, these limited number of publications have relatively smaller patient enrolments, follow-up periods and treatment options availability. Hence, the current study aims to research the long-term effects of COVID-19 pandemic on treatment approaches and outcomes of distal radius fractures in a Level I trauma center. Objectives were to examine and study the patient population of distal radius fractures presenting before, during and after COVID-19 lockdown time periods, evaluate the radiological parameters and management protocol of fractures, review the functional and radiological outcomes of each cohort with long term follow-up and to determine the effects of pragmatic treatment guidelines on level of input of orthopaedic services, patient outcomes and complications.

## **II. Materials And Methods**

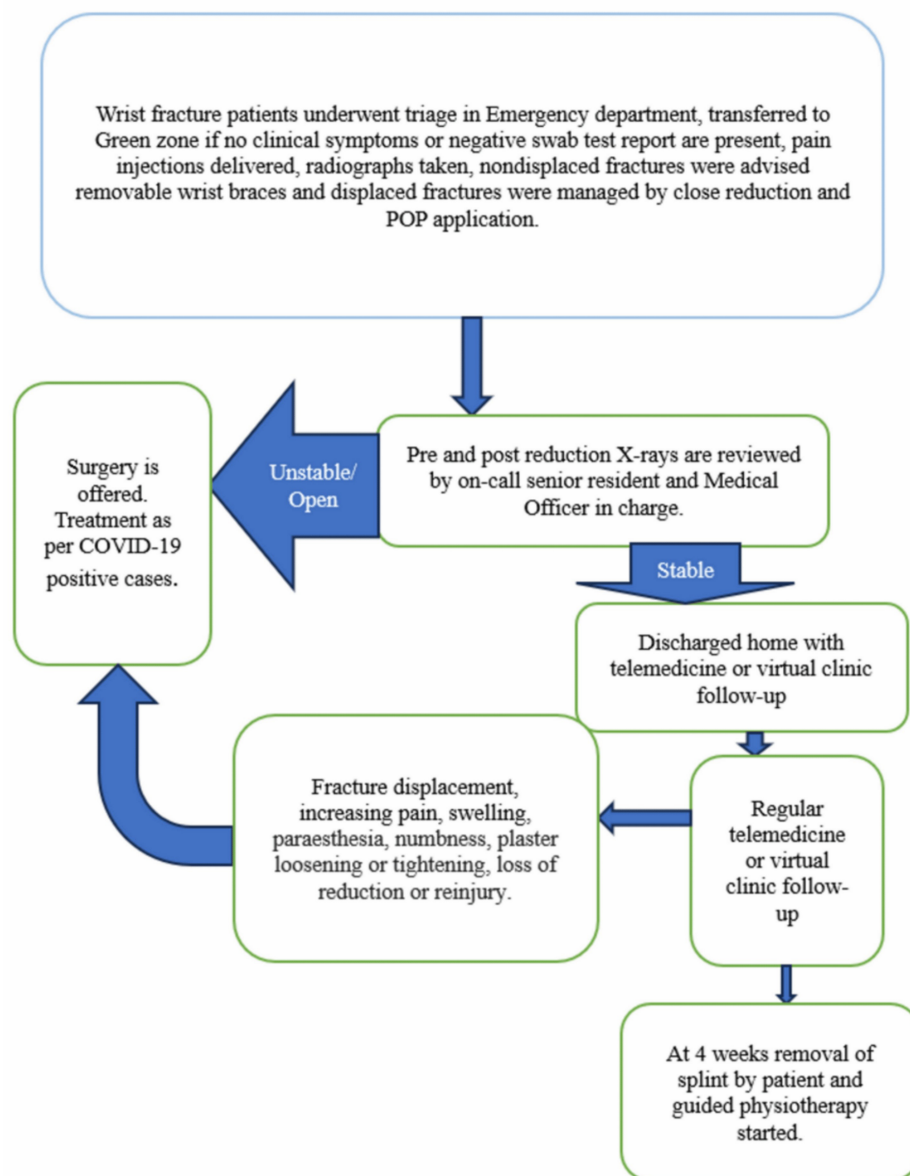
A longitudinal retrospective cohort study was conducted at Orthopaedics department of the tertiary care center. Patients between 18-65 years of age were enrolled in the study after clarifying the following exclusion criteria: COVID-19 positive patient, a Gustilo-Anderson type-3 compound fracture, a congenital anomaly, a pathological fracture other than an osteoporotic fracture, alcohol and drug abuse and history of previous comorbidities or concurrent illness or injury biasing the rehabilitation and evaluation protocol.

Successive distal radius fractures of patients in pre-COVID (2018-19), COVID (2020-21) and post-COVID (2022-23) time period groups were studied. Data collection included patient demographics, radiological classification, management, follow-up, radiological parameters, functional outcomes and ensuing complications. The primary outcome was the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) score, and secondary outcomes included wrist range of motion, grip strength and pain. Findings of cohorts of all time periods were then compared. Patients were followed-up monthly till 3 months and every 3 months thereafter until fracture union and complete rehabilitation.

### *Distal radius fracture treatment approach during COVID-19 pandemic*

Patient presenting with a wrist fracture was initially advised to put on a N-95 mask and subsequently checked for covid symptoms in the triage area. Body temperature was measured by portable thermal camera. A swab test was conducted. Once the patient enters the Green zone, he is managed by surgical residents wearing PPE kits. Green zone is airtight and no patient having COVID-19 symptoms, high body temperature or a positive swab test report is allowed to enter. Patient is investigated radiographically and pain injections are delivered. Initial management is done by close reduction and Plaster of Paris application. Check X-rays are performed and adequacy of reduction is judged against risk to benefit ratio. If deemed satisfactory, patient is discharged on oral medications with proper written instructions regarding plaster care, active finger movements and limb elevation. He is guided to consult through telemedicine or virtual clinic on a regular basis and to practice social distancing to decrease viral transmission risk.

During telemedicine or virtual clinic necessary attention is made on any worrying symptoms of pain, swelling, paraesthesia, numbness, plaster loosening or tightening, loss of reduction or reinjury. At 1 month patient is advised to remove slab and practice regular physiotherapy as taught. If fracture is irreducible, patient is admitted for surgery and tested for COVID-19 according to the protocol. No positive patient is operated. Patients are operated only after their two consecutive reports are negative. [Figure 1]



**FIGURE 1: Flow diagram of pragmatic management approach during COVID-19 pandemic.**

*Surgical Technique*

All surgeries were performed under constant supervision of the senior surgeons by surgeons having minimum 5years experience. Brachial block was used in all cases for anaesthesia. For all fixation surgeries, operative planning and discussion was conducted for reaching a judicious consensus about operative techniques and steps to be executed after careful pre-operative clinical assessment of general health and local soft tissue status of the patient. Surgeon’s intraoperative assessment of fracture reduction and stability achievable by ligamentotaxis and percutaneous pinning initially, guided case-based decision-making. For successful fixation and normal healing process, mode of intervention was based on the intraoperative assessment of fracture pattern under traction, location and degree of capsuloligamentous stability left post injury that required either external or internal fixation for postsurgical stability.

*Percutaneous Kirschner wires*

First step was to view the fracture under traction in C arm machine and perform manual reduction and alignment of the major fracture fragments by using longitudinal traction-countertraction method while carefully manipulating the hand in palmar and ulnar deviation. Fracture was anatomically reduced by manually holding the fractured volar and dorsal radial cortices and using gentle hand pressure to align them anatomically and fixed by drilling percutaneous divergent Kirschner wires from superficial dorsal and lateral surface of distal radius getting hold of the major bony fracture fragments. Radial styloid bony fragment is reduced and radial

height maintained by placing divergent Kirschner wires from dorsal and volar border of base of radial styloid, 45 degrees across the fracture into proximal bony cortex of radial shaft along the interosseous border. Gradual fingertip pressure is used to reduce the volar cortex and volar ulnar fracture fragment. Kirschner wires can be judiciously used by inserting them into the bare volar rim after doing clinical palpation to avoid neurovascular structures and passing underneath the overlying volar cortex bony fragments to be hinged proximally into the posterior or lateral surface of radial shaft. The distal radioulnar joint is reduced in neutral or supination position of forearm and fixed by passing a Kirschner wire parallel to the radiocarpal joint line from distal ulna, inserting below the sigmoid notch and hinging into intact lateral radial cortex. The Kirschner wires were bent, cut and exposed. An above elbow plaster of Paris slab was applied and kept in an arm pouch for 3 weeks.

#### External fixation with wrist distractor

In high energy traumatic unstable fractures having varying degrees of bony comminution and segmentation, it is essential to provide sustained ligamentotaxis after percutaneous Kirschner wires fixation by application of a spanning bridging external fixator containing a distraction unit attached to the connecting rod. Care should be taken to prevent over-distraction of the fracture site while increasing distraction from the attached distraction unit. The fracture ends must be in contact for bony healing to occur.

#### Internal fixation with volar locking plates

In volar barton fractures and unstable fractures having high degree of volar cortex comminution, segmentation and bony displacement modified Henry approach to the distal end radius was used to access the fracture. The joint capsule was protected and left intact. A volar locking plate of appropriate size was placed proximal to the attachment of volar radiocarpal ligament and provisionally fixed with K-wires into the radial shaft. C arm views were obtained to verify anatomically contoured plate positioning. A cortical screw was placed in the shaft near the fracture site so to provide gliding effect and exact buttressing of the distal fracture fragments. Small bony fragments free from all sides should be kept supported under the plate in anatomical alignment with the judicious help of multidirectional K-wires. Distal locking screws in the plate should be applied only after assessment of the bony stock available capable of providing firm screw hold and directing them superiorly parallel to the wrist joint surface after aligning the wrist in palmar flexion and ulnar deviation so as to correct volar tilt and radial height. 3 or 4 screws were used in the shaft and 3 to 5 locking screws were employed to fix the distal part of the radius. Care should be taken to avoid placement of screws in fracture lines and placing screws of exact sizes to prevent dorsal cortex penetration.

#### Statistical Analysis

Repeated-measures analysis of variance was employed to collate the three groups with respect to primary and secondary outcomes. Powerful overall comparisons were made between all groups observed over time only when the overall repeated-measures tests were statistically significant ( $p < 0.05$ ). All scale variables were tested for normality using the Kolmogorov Smirnov test. Parametric continuous variables were compared using an independent Student t-test. Chi square test was employed to compare dichotomous variables. The Mann Whitney U statistic was applied to non-parametric scale variables and ordinal variables. Homogeneity of variance was assessed using Levene's test. Fisher's exact test was used to compute the p values.

#### Ethical Statement

The study was conducted in accordance with the Declaration of Helsinki and guidelines for good clinical practice. Informed written consent was taken from all patients.

### III. Results

Present sampling had 348 patients of 353 distal radius fractures with 5 patients having bilateral injuries. Grouping created 118 patients in pre-COVID (2018-19), 98 in COVID (2020-21) and 132 in post-COVID (2022-23) time period groups. Mean age of patients was 43.8 years. Majority of them were males [211(61%)] and remaining were females [137(39%)]. There were statistically significant demographic differences between the groups. Even distribution was noticed among the subcategories of fracture patterns according to the OTA/AO classification system. [Table 1]

In pre-COVID group 97(82.2%) patients presented within 3 days of injury which significantly declined to 48(49%) in COVID and 94(71.2%) in post-COVID group. COVID group had a significantly lower number of patients evaluated in face-to-face out-patient visits and also mean number of out-patient department visits was significantly decreased as majority of the patients were consulted using telemedicine and virtual clinic. There was a significant reduction in admissions for inpatient care ( $p < 0.05$ ). Fracture management in all cohorts included both conservative and operative treatment approach. In COVID cohort, close reduction and plaster application was the final treatment in maximum 61(63%) patients. [Figure 2]

Comparatively, 54(46%) patients in pre-COVID and 55(42%) patients in post-COVID cohort were treated conservatively. Between the 3 groups, patients receiving operative treatment were 64(54.2%), 36(36.7%) and 77(58.3%) respectively. Operative techniques employed were close reduction and percutaneous Kirschner wire fixation, augmented wrist distractor and open reduction internal fixation with volar locking plates. Union was seen in 3 months in 108(91.5%), 92(93.8%) and 123(93.2%) patients in the 3 groups respectively. Mean follow-up was of 2years with total 338 (97.1%) patients having normal union and recovery. [Table 2]

The duration of physiotherapy and rehabilitation protocol was minimum (mean 4.1 months) for the COVID group and maximum (mean 7.5 months) for the post-COVID group. The duration of stay was minimal (mean 3.5 days) for the COVID group and maximum (mean 6.7 days) in the post-COVID group. Radiological and functional outcomes at 1 and 2years follow-up were analogous in all the 3 groups. The mean QuickDASH score at 1 year follow-up was 7.2(8.6) in COVID group that was clinically better than pre-COVID [8.5(9.2)] and post-COVID [9.7 (12.4)] cohorts. [Table 3]

At 2years, functional recovery was sustained through educable physical exercises with COVID group displaying closer near-normal anatomical restoration of radiological parameters. [Table 4]

Subgroup analysis revealed that patients receiving conservative plaster treatment for stably reduced fractures uniformly displayed excellent results across the 3 cohorts. Patients successfully treated with close reduction and percutaneous K-wires fixation showed early recovery and marginally better functional outcomes in comparison to other treatment methods. The long-term outcomes of external fixation were clinically more satisfactory than internal fixation.

#### *Complications*

Overall, early complications seen in the 3 cohorts respectively included loss of reduction in plaster [8(7%), 14(14%), 12(9%) patients], pain and swelling in plaster [6(5%), 18(18%), 19(10%) patients], local pin site infection and loosening [5(4%), 8(8%), 7(5%) patients] and stitch line or wound infection [5(4%), 1(1%), 13(10%) patients]. Late complications did occur but were infrequent and comparable in all 3 groups. They respectively comprised of minor complications such as complex regional pain syndrome [3(2.5%), 2(2%),

4(3%) patients], residual distal radioulnar joint instability [2(1.7%), 1(1%), 4(3%) patients] and delayed union [1(1%), 1(1%), 2(1.5%) patients] which was successfully treated by targeted active physiotherapy. Major complications noticed across 3 cohorts respectively were malunion [3(3%), 2(2%), 4(3%) patients] and nonunion [2(1.7%), 1(1%), 3(2.3%) patients]. No significant differences were found among the 3 cohorts in terms of complications rate. However, across all 3 cohorts, malunion was seen exclusively in patients receiving conservative close reduction and plaster application while non-union was visible exclusively in patients receiving open reduction and internal fixation. Major complications were recorded in 5(4%) patients in preCOVID, 3(2%) in COVID and 7(5%) in post-COVID cohort without any statistically significant differences. However, the number of reoperations or secondary surgeries required were significantly lower in the COVID group [1 (1%) patient]. Post-COVID group had highest number of reoperations, either to correct non-union [3(2.3%) patients] or implant removal [3(2.3%) patients] due to hardware prominence. Comparatively minimal complications and prompt recovery were seen in patients being operated by percutaneous Kirschner wires fixation [Figure 3].

#### **IV. Discussion**

Current study had certain inter-cohort demographic differences. COVID group had lower number of patients, majority being manual labourers sustaining low energy trauma and presenting in a relatively delayed manner. Post-COVID group had higher number of patients, with comparatively younger mean age, majority being daily office workers enduring high energy trauma and acute presentations. These epidemiological findings substantiate previous studies showing a decrease in patient load due to lockdown restrictions during pandemic and reactional increments in the post-COVID groups. [8,9] Meanwhile, the incidence of fragility fractures remained static across all time periods. Time until surgery and duration of stay was minimum in the COVID group so as to avoid overcrowding in wards and lower risk of infection.

Close reduction and below elbow plaster application was performed for all patients uniformly on presentation. Stable extra-articular distal radius fractures resulting from low energy injuries usually get reduced comfortably and show minimal post-reduction displacements. They unite very well in four weeks and functional recovery is also swift if proper guided rehabilitation protocol is genuinely followed. However intraarticular fractures and fractures in osteoporotic bones have a tendency to displace in the early postreduction phase. They need regular monitoring for early detection of loss of reduction so that operative surgery for anatomical restoration can be advised to the patient. Minor displacements in plaster results in nonsignificant malunion that shows near complete functional recovery post rehabilitation. Gradual bone remodelling self corrects the minor radiological deformity over time. Resistance training inclusion into the physiotherapy program post 3 months of sufficient fracture consolidation remodels the bone and leads to clinically satisfying functional outcomes.

Unstable fractures resulting from high energy trauma show extreme fracture displacements that are unamenable to close reduction in the emergency rooms. Majority of the patients in COVID group that underwent surgery had percutaneous Kirschner wires fixation after close reduction under C-arm guidance. Their functional results demonstrated a steeper slope when compared to the other groups. Although marginally, their scores were better than those of the remaining groups across all follow-ups. The percentage of patients being operated by open reduction and internal fixation by volar locking plates saw a steady rise in the post-COVID cohort. Associated complications also inclined. Secondary surgeries for osteosynthesis and reoperations were significantly more in the post-COVID group. Application of a wrist distractor to unstable distal radius fractures resulted in uniform establishment of anatomical integrity across all the 3 cohorts with corresponding functional outcomes gradually reaching normality through regularly guided physiotherapy. Considering the COVID group, no decline in patient outcomes and satisfaction levels were seen despite of lesser face-to-face follow-up visits and lesser number of total follow-up consultations.

Nominal differences were found in the fracture patterns of patients presenting in all groups. The decrease in number of cases presenting to the hospital and being provided inpatient care was significant in the COVID group. The treatment approach to fracture witnessed a shift from frequent out-patient clinic visits to regular online virtual clinics or telemedicine. This in turn significantly reduced virus exposure and transmission rate. Social distancing was very well maintained as only selected patients were called for out-patient clinic visits. Patients in the COVID group required comparably equal number of clinic appointments. This transition did not alter the functional outcomes of patients in the COVID group. Telemedicine helped in early identification of cases requiring operative treatment among patients sent home after conservative close reduction and plaster application. This kept the number of late major complications low. Compliance issues were minimal with telemedicine as indicated in earlier studies. [10]

In the COVID group, comparatively more patients were treated by close reduction and plaster application or with removable wrist braces in compliance with the treatment guidelines that suggest a more empirical conservative approach to management during lockdown. No differences were noticed with either splint as suggested previously. [11] Among those operated, comparably greater number of patients had percutaneous K-wire fixation after close reduction under fluoroscopic guidance. Only carefully selected ones received open reduction internal fixation or wrist distractor application. This contrasts with the other two cohorts that similarly received significantly higher numbers of latter. This pragmatic treatment approach gave equal union rates and slightly better functional outcomes. Percutaneous Kirschner wire fixation surgery is a minimum intervention technique that yields quicker biological solid callus formation as a result of quick secondary bone healing, provided anatomical reduction is achieved correctly intraoperatively and soft tissue is preserved. This is in compliance with findings of past similar global researches. [6,7,12,13] The small distal fracture fragments get ensuring fixation and hold by 2 mm Kirschner wires inserted divergently across the fracture site. This method showed versatility even in fracture patterns having volar displacement of distal fracture fragments. [Figure 4]

No significant difference was evident between the three cohorts regarding complications or need for secondary osteosynthesis. Majority of the latter occurred in patients being operated by open reduction and internal fixation. Lack of screws hold in comminuted distal fracture fragments precipitating post-surgical fracture displacement, implant misplacement and infection were the causal factors associated. They were reoperated, implant removal along with external fixation was performed and all of them had good recovery. Implant prominence is an issue that prevents full functional execution in internally fixed patients resulting in a slightly higher pain apprehension, especially in lean patients. Resistance training program is highly recommended for such patients.

Regularly monitored physiotherapy and rehabilitation regime followed by the patients resulted in swift return to pre-injury functional level across all 3 cohorts. This is clinically comforting to a point, although in the past it was apprehended that the change in treatment approach during the COVID-19 pandemic might cause higher corrective elective upper limb workload. [5] The conservative approach of surgery selection as minimum intervention in COVID cohort can be safely extended to normal practice as skilful percutaneous fixation ensures return to preinjury status. In the COVID group a decrement was evident in the overall number of radiographs being taken for each patient, intraoperative C-arm exposure and blood loss. Hospital stay was also minimised. This decreased the workload on the hospital staff and made them available for posting in COVID wards. This load sharing worked efficiently in handling the highly spiked number of patients during the COVID waves in lockdown. Also, resource allocation was priority based which prevented its scarcity. No evidence was found regarding an increase in risk of COVID infection among the treating surgeons and hospital staff with the pragmatic treatment approach used during pandemic.

Current study has certain limitations being of retrospective cohort design. Blinding was not followed due to nature of surgical procedure. Similar surgeons managed, operated and rehabilitated patients in order to

maximise follow-up. Being a single center study, its validity and generalisability need to be verified in future extended multi-center studies with larger sample size.

## V. Conclusions

COVID-19 pandemic had minimal effects on functional results of distal radius fractures as the conservative treatment approach utilised was realistic and beneficial to the patients as well as to the treating surgeons. Timely corrections of the arising early treatment complications through efficient virtual clinics/telemedicine kept the prevalence of major late complications minimal. The results of precisely performed close reduction and percutaneous fixation of distal radius fractures are encouraging and lead to early complete functional recovery when compared to other treatment options. This basic minimum intervention technique is recommended in unstable fracture patterns in order to gain timely normal recovery. Clinically relevant advantages of this management techniques are its easy expandability to normal practice with ensuring long term outcomes and safe return of patient to normal level of activity as evident by the relative results of COVID cohort.

This research highlights the clinically rewarding benefits of managing complex unstable intraarticular fracture patterns with external fixation ahead of internal fixation, in terms of better patient's functional revival and minimal complications rate. The benefits of strong secondary biological fracture healing in the metaphyseal bone should be availed of in majority of the cases. Hence, we recommended regular practicing of external fixation techniques uniformly in all patients of unstable distal radius fractures requiring operative intervention, clinical assessment of the hold of relative stable construct and switching onto open reduction and internal fixation only in selected cases requiring further absolute stability.

### Additional Information

#### Disclosures

**Human subjects:** Consent was obtained or waived by all participants in this study.

**Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue.

**Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following:

**Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work.

**Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

**Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

## References

- [1] "Archived: Who Timeline - Covid-19". (2020) World Health Organisation. 27 April. Archived From The Original On 29 April. (2020). <https://www.who.int/news/item/27-04-2020-who-timeline-covid-19>.
- [2] Andrews Ma, Areekal B, Rajesh Kr, Et Al.: First Confirmed Case Of Covid-19 Infection In India: A Case Report. *Indian J Med Res.* 2020, 151:490-492. 10.4103/Ijmr.Ijmr\_2131\_20
- [3] Indian Orthopaedic Association. (2020: Covid-19 Ioa Guidelines. New Delhi: Indian Orthopaedic Association.
- [4] Boa T, Nhse T, Guides S. (2020: Management Of Patients With Urgent Orthopaedic Conditions And Trauma During The Coronavirus Pandemic. 1:6.
- [5] Baawa-Ameyaw J, Kabariti R, Chandra A, Rhee J. (2020: The Theoretical Impact On Corrective Upper Limb Elective Services Following Analysis Of Distal Radius Fractures Managed Nonoperatively During Covid-19 Pandemic. *Bone Jt Open.* 1:612-616. 10.1302/2633-1462.110.Bjo-2020-0126.
- [6] Harvey J, Varghese Bj, Hahn Dm. (2021: Displaced Distal Radius Fracture: Reduction, Follow-Up, And Clinical Outcomes: Learning From A Pragmatic Approach During The. 202019, 2:338-343. 10.1302/2633-1462.25.Bjo2021-0015.
- [7] Walker Lc, O'connor D, Richards Sw, Southgate Jj. (2022: The "Covid-19 Approach" To Distal Radius Fracture Management. *J Wrist Surg.* Oct 4;12(2): 121-127. 10.1055/S-0042-1756496. Pmid: 36926211 Pmcid: Pmc10010892. 10.1055/S-0042-1756496
- [8] Candela, V.; Proietti, R.; Polizzotti, G.; Rionero, M.; Gumina, S: Three Years Of Covid-19 On Orthopaedic Trauma; Are We Going Back To Normality?. *Medicina.* 2023, 59:1464.
- [9] Olech J, Ciszewski M, Morasiewicz P: Epidemiology Of Distal Radius Fractures In Children And Adults During The Covid-19 Pandemic - A Two-Center Study. *Bmc Musculoskelet Disord.* 2021, 1186:7995382.
- [10] Arvidsson L, Hägglund B, Petersson L, Arvidsson E, Tägil M: Virtual Follow Up After Distal Radius Fracture Surgery-Patient Experiences During The Covid-19 Pandemic. *J Patient Exp.* 2023, 24:23743735231188819. 10.1177/23743735231188819.
- [11] Newman S, Singh A, Ramesh A, Mahomed E, Millar T: Changing To Removable Casts During The Coronavirus Pandemic-Has It Affected Outcomes For Distal Radius Fractures?. *Sn Compr Clin Med.* 2021:2401-2406.
- [12] Costa Ml, Achten J, Plant C, Et Al.: Uk Drafft: A Randomised Controlled Trial Of Percutaneous Fixation With Kirschner Wires Versus Volar Locking-Plate Fixation In The Treatment Of Adult Patients With A Dorsally Displaced Fracture Of The Distal Radius. *Health Technol Assess.* 2015, 19:1-124. 10.3310/Hta19170.
- [13] Maliyappa C, Raghupathi A, Rupasinghe D, Iancu P, Mohamed M, Qazzaz L: Outcome Analysis Of Adult Distal Radius Fractures Managed During Covid-19 Pandemic. *Journal Of Orthopaedic Case Reports.* 2023, 13:53-57. 10.13107/Jocr.2023.V13.I10.3934.



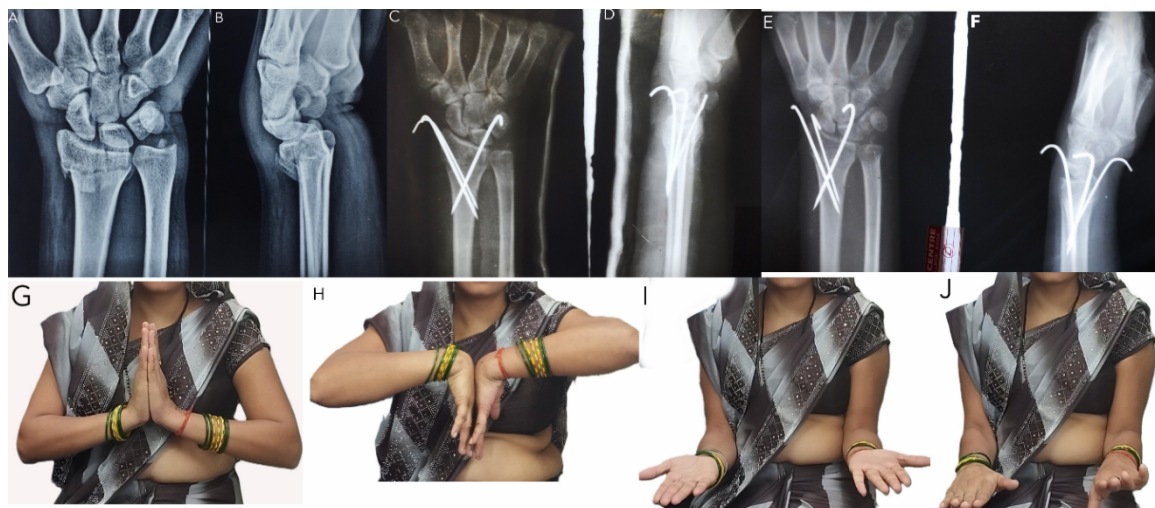
**FIGURE 2:** Conservative treatment done in pre-COVID group by close reduction plaster application in a 38 year old female patient.

A,B- Postinjury anteroposterior and lateral radiographs showing dorsal displacement.

C,D- Postreduction lateral and anteroposterior radiographs showing excellent reduction.

E,F- 1 month follow-up anteroposterior and lateral radiographs showing solid callus formation.

G,H- 2 months follow-up anteroposterior and lateral radiographs showing healthy bone union.



**FIGURE 3:** A 30 years old female patient, having intra-articular distal radius fracture of left side, treated by percutaneous Kirschner wires fixation in COVID group.

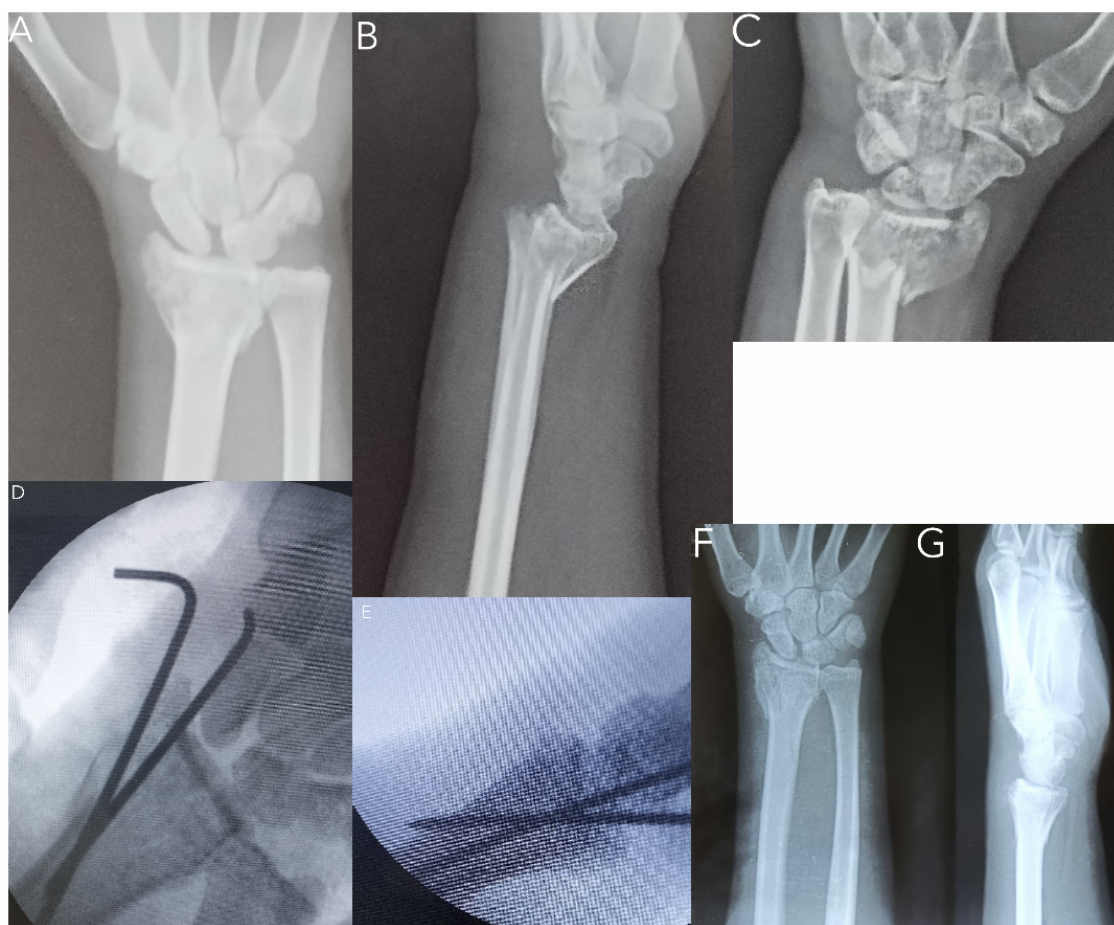
A,B- Postinjury anteroposterior and lateral radiographs showing intraarticular distal radius fracture.

C,D- Postoperative anteroposterior and lateral radiographs showing close fixation of volar ulnar fracture fragment.

E,F- 1 month follow-up anteroposterior and lateral radiographs showing solid callus formation in anatomical alignment.

G,H,I,J- Clinical photos of patient at 2 years follow-up showing normal recovery of left wrist in extension, flexion, supination and pronation.





**FIGURE 4:** A 41 years old male patient treated by percutaneous Kirschner wires fixation in COVID group. A,B,C- Preoperative anteroposterior, lateral and oblique radiographs showing intra-articular distal radius fracture with volar displacement of distal fracture fragment.

D,E- Intraoperative anteroposterior and lateral images.

F,G- 1 month follow-up anteroposterior and lateral radiographs, post wire removal, showing solid bone union in anatomical alignment.

**Table 1: Baseline and demographic characteristics of 3 cohorts.**

Characteristic	Pre-COVID (2018-19)	COVID (2020-21)	Post-COVID (2022-23)
Number of patients	118	98	132
Age at injury*(year)	47(10.2)	45(12.1)	39(8.4)
Male/female (no. [%])	72(61%)/46(39%)	58(59%)/40(41%)	81(61%)/51(39%)
OTA/AO fracture type (no. [%])			
2R3A1	5(4.2%)	2(2%)	4(3%)
2R3A2	12(10.2%)	11(11.2%)	14(10.6%)
2R3A3	18(15.2%)	19(19.4%)	22(16.7%)
2R3B1	15(12.7%)	11(11.2%)	14(10.6%)
2R3B2	9(7.7%)	6(6.1%)	11(8.3%)
2R3B3	7(6%)	5(5.1%)	6(4.5%)
2R3C1	16(13.5%)	15(15.4%)	19(14.4%)
2R3C2	22(18.6%)	18(18.4%)	25(19%)
2R3C3	14(11.9%)	11 (11.2%)	17(12.9%)
Injury in dominant hand (no. [%])	64(54%)	58(59%)	74(56%)

Mechanism of injury (no. [%])			
Low-energy trauma	52(44%)	50(51%)	54(41%)
High-energy trauma	66(56%)	48(49%)	78(59%)
Occupation (no. [%])			
Office work	54(46%)	35(36%)	61(46%)
Manual labour	36(31%)	45(46%)	39(30%)
Retired	24(20%)	16(16%)	26(20%)
Other	4(3%)	2(2%)	6(4%)
Time of presentation since injury (no. [%])			
<3 days	97(82.5%)	48(49%)	94(71%)
4-7 days	18(15%)	39(40%)	29(22%)
>1 week	3(2.5%)	11(11%)	9(7%)
Time until surgery* (days)	3.8(4.5)	2.4(3.7)	4.5(4.9)
*The values are given as the mean and SD			

**Table 2: Management and follow-up of 3 groups**

Cohort	Pre-COVID	COVID	Post-COVID
Management, n (%)	N=118	N=98	N=132
Conservative	54 (46%)	61 (63%)	55 (42%)
Percutaneous Kirschner wires	22(19%)	27(27%)	33 (25%)
External fixation Wrist distractor	23(19%)	6(6%)	21 (16%)
Internal fixation Volar locking plates	19(16%)	4(4%)	23 (17%)
Follow-up, n(%)			
Out-patient clinic	118 (100%)	0	132 (100%)
Virtual clinic	0	32 (33%)	0
Telemedicine	0	66 (67%)	0
Time of stay in hospital in days*	5.5(7.3)	3.5 (4.3)	6.7(5.2)
Union time in months*	3.1(4.5)	2.7(3.5)	3.4(5.2)
Rehabilitation period in months*	5.4(6.7)	4.1(3.8)	7.5(5.7)
Major Complications rate, n(%)	5 (4%)	2 (2%)	7 (5%)

\*The values are given as mean (SD).

**Table 3 Functional Outcomes at 1year Follow-up Evaluation in 3 groups**

Cohort	Pre-COVID(N=118)		COVID(N=98)		Post-COVID (N=132)	
QuickDASH score*	8.5(9.2)		7.2(8.6)		9.7 (12.4)	
Pain VAS score*	0.7 (1.2)		0.5 (1.1)		0.8 (1.3)	
Range of motion in degrees*#						
<b>Flexion</b>	65.4 (8.4)	94%	68.4 (7.2)	97%	63.2 (12.1)	90%
<b>Extension</b>	70.6 (8.7)	97%	71.7 (9.4)	99%	69.7 (10.5)	96%
<b>Pronation</b>	87.2 (9.5)	98%	88.8 (8.3)	99%	86.8 (9.1)	97%
<b>Supination</b>	87.7(8.2)	99%	88.7 (6.2)	100%	87.1 (11.2)	98%
<b>Grip Strength (kg)</b>	30.3 (9.3)	95%	31.8 (7.9)	99%	30.1 (11.9)	92%
* The values are given as mean (SD). # The values are given as percentage of normal uninjured wrist.						

*Long Term Effects Of Covid-19 Pandemic On Management And Outcomes Of Distal Radius Fractures*

Measure	Mean	Difference	SD	Mean	Difference	SD	Mean	Differenc	SD
Preoperative									
Volar tilt(degrees)	-22.04	16.8	19.2	-19.2	15.4	13.2	-23.91	18.1	16.3
Radial inclination(degrees)	9.4	5.7	5.5	10.1	4.4	4.7	10.39	4.9	5.1
Radial length(mm)	3.92	2.4	3.1	4.8	2.1	2.9	4.04	2.6	3.0
Intraarticular step(mm)	2.44	1.9	1.3	2.31	1.7	1.2	2.26	1.7	1.1
Intraarticular gap(mm)	2.86	2.3	1.1	2.77	2.1	1.1	2.68	2.2	1.2
Postoperative									
Volar tilt(degrees)	9.63	3.1	7.2	9.4	3.4	5.8	9.1	3.9	6.3
Radial inclination(degrees)	20.4	1.3	4.7	20.5	1.1	5.1	20.9	0.7	5.3
Radial length(mm)	10.5	0.9	2.9	10.5	0.8	2.7	10.67	0.7	2.4
Intraarticular step(mm)	0.33	0.3	0.7	0.26	0.2	0.5	0.24	0.2	0.6
Intraarticular gap(mm)	0.44	0.4	0.8	0.4	0.3	0.7	0.48	0.5	0.8
At 2 years follow-up									
Volar tilt(degrees)	8.13	4.2	6.5	9.1	3.2	5.2	7.7	4.7	6.1
Radial inclination(degrees)	19.94	1.5	4.6	20.2	1.3	3.4	19.74	1.7	4.1
Radial length(mm)	10.4	1.1	3.1	10.4	0.9	3.8	10.2	1.0	2.8
Intraarticular step(mm)	0.15	0.2	0.7	0.11	0.1	0.5	0.17	0.2	0.6
Intraarticular gap(mm)	0.15	0.2	0.5	0.1	0.1	0.4	0.16	0.2	0.6

\*Mean difference from normal uninjured wrist

**TABLE 4: Radiographic parameters at 2 years follow-up evaluation in 3 cohorts.**