

## ■ WRIST &amp; HAND

# Displaced distal radius fracture: reduction, follow-up, and clinical outcomes

LEARNING FROM A PRAGMATIC APPROACH DURING THE 2020 COVID-19 LOCKDOWN TRANSITION



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## Aims

Displaced distal radius fractures were investigated at a level 1 major trauma centre during the COVID-19 2020 lockdown due to the implementation of temporary changes in practice. The primary aim was to establish if follow-up at one week in place of the 72-hour British Orthopaedic Association Standards for Trauma & Orthopaedics (BOAST) guidance was safe following manipulation under anaesthetic. A parallel adaptation during lockdown was the non-expectation of Bier's block. The secondary aim was to compare clinical outcomes with respect to block type.

## Methods

Overall, 90 patients were assessed in a cross-sectional cohort study using a mixed, retrospective-prospective approach. Consecutive sampling of 30 patients pre-lockdown (P1), 30 during lockdown (P2), and 30 during post-lockdown (P3) was applied. Type of block, operative status, follow-up, and complications were extracted. Primary endpoints were early complications ( $\leq$  one week). Secondary endpoints were later complications including malunion, delayed union or osteotomy.

## Results

In P1, 86.6% of patients were seen between days one to three, 26.7% in P2, and 56.7% in P3. There were no documented complications from days one to three. Operative rate was 35.5%, which did not vary significantly ( $p = 0.712$ ). Primary endpoints occurred between day four to seven, and included one patient each period treated for plaster cast pain. Secondary endpoints in P1 included delayed union (one patient). During P2, this included malunion (one patient), a pressure sore (one patient) and ulnar cutaneous nerve symptoms (two patients). In P3, malunion was identified in one patient. Mean follow-up was six months (4 to 9) with union rate 96%. Change in block practice varied significantly ( $p < 0.05$ ). The risk ratio of complications using regional block (Bier's) over haematoma block was 0.65.

## Conclusion

Follow-up adaptations during lockdown did not adversely affect patient outcomes. Regional anaesthesia is gold standard for manipulation of displaced distal radial fractures.

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## Introduction

The British Orthopaedic Association Standards for Trauma and Orthopaedics (BOAST) have advised a pragmatic approach to fracture management during the COVID-19 pandemic.<sup>1</sup> Distal radius fractures are the

second most common fragility-type fracture worldwide.<sup>2</sup> The British Orthopaedic Association (BOA) and British Society for Surgery of the Hand (BSSH) support the guidance from the National Institute for Health and Care Excellence (NICE) to recommend intravenous

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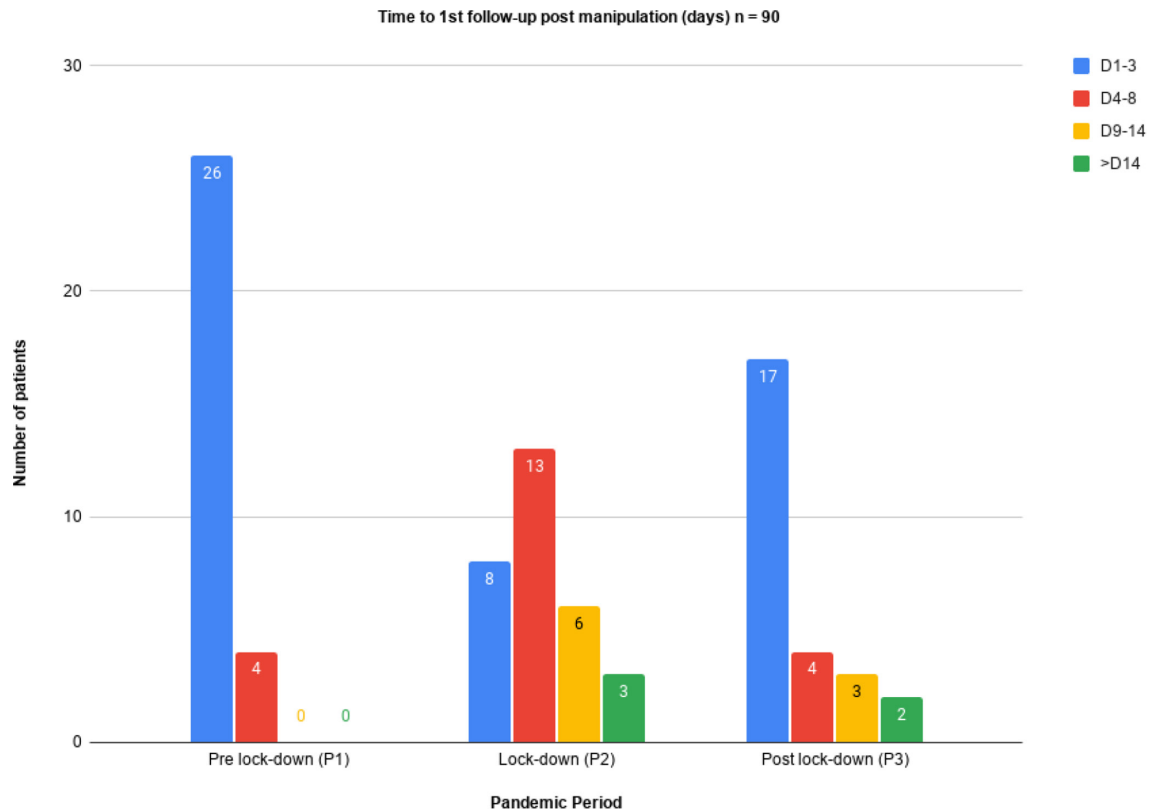


Fig. 1

A comparison of follow-up practice following manipulation under anaesthetic during the COVID-19 pandemic.

**Table I.** Operative management and timing following manipulation under anaesthetic.

Pandemic period 2020	Day of patient operation				Total, n (%)
	0 to 3	4 to 8	9 to 14	> 14	
P1	4	4	3	1	12 (40)
P2	3	5	1	2	11 (37)
P3	4	2	2	1	9 (30)

P1, pre-lockdown February to March; P2, lockdown April to May (prospectively); P3, post-lockdown July.

regional anaesthesia (Bier's block) for those that require manipulation under anaesthetic (MUA).<sup>3,4</sup> NICE advise that fractures with stability in question should be followed up within two weeks. This applies to all manipulated distal radius fractures. BOAST goes further to state that patients should be assessed by the fracture clinic service within 72 hours.<sup>5</sup>

Normal practice in our major trauma centre (Queens Medical Centre, UK) is for patients with displaced distal radius fracture (DDRF) to be referred directly from A&E to the orthopaedic registrar on call, who arranges manipulation under Bier's block alongside the senior house officer on call in the fracture clinic plaster room. They are then seen the next working day in the post-take consultant-led fracture clinic. If the patient presents to A&E

**Table II.** Overall complications with respect to timing and pandemic period.

Pandemic period 2020	Number of patients with complications, days			
	0 to 3	4 to 8	9 to 14	> 14
<b>P1 (n = 30)</b>				
Plaster cast pain		1		1
CRPS				1
Delayed union				1
CTD				1
<b>P2 (n = 30)</b>				
Plaster cast pain		1	1	2
Deformity/malunion		1		1
Pressure sores				1
Neurological sx		1		1
<b>P3 (n = 30)</b>				
Plaster cast pain		1		
Delayed union				1

CRPS, complex regional pain syndrome; CTD, carpal tunnel decompression.

P1, pre-lockdown February to March; P2, lockdown April to May (prospectively); P3, post-lockdown July.

after the Bier's block facility is closed (19:00 hrs), they are asked to return the next day for MUA followed by fracture clinic the day after. This amounts to three consecutive hospital visits.

**Table III.** Comparison of union rates between nonoperative and operative patients during each COVID-19 pandemic period.

Pandemic period 2020	Lost to follow-up, excluded, n	Nonoperative % union rate (n)	Operative % union rate (n)	Total % union rate (n)
P1	2/30	100 (16)	92 (12)	96 (28)
P2	1/30	91 (18)	100 (11)	97 (29)
P3	3/30	89 (18)	100 (9)	96 (27)

P1, pre-lockdown February to March; P2, lockdown April to May (prospectively); P3, post-lockdown July.

**Table IV.** Use of Bier's block, haematoma block, and inhaled analgesia during the three COVID-19 pandemic periods.

Pandemic period 2020	Block		Other method	
	Bier's, n (%)	Haematoma, n (%)	Entanox, n (%)	Pentrox, n (%)
P1	20 (66.7)	9 (30)		1 (3.3)
P2	9 (30)	20 (66.7)	1 (3.3)	
P3	19 (63.3)	11 (36.7)		

\*Chi-squared test.

P1, pre-lockdown February to March; P2, lockdown April to May (prospectively); P3, post-lockdown July.

Our Trauma and Orthopaedics department developed a rapid contingency plan prior to the COVID-19 lockdown on 23 March 2020 in order to reduce the risk of nosocomial infection.<sup>6</sup> Given the potential risk that the aforementioned multiple attendances to hospital in a vulnerable population would pose, first follow-up was extended to one week with wrist radiograph on arrival, alongside the usual BOA casting standards of care.<sup>7</sup> In addition, during lockdown a locally accepted non-conformation with BOAST was permitted which allowed haematoma block to replace the standard Bier's block in order to minimize time spent in hospital.

The primary aim was to investigate if this local pandemic adaptation increased the risk of early ( $\leq$  one week) or later complications. A secondary aim of this study was to determine if there was an additional risk of complications in not using Bier's block.

## Methods

This is a cross-sectional study of displaced distal radius fractures before, during, and after COVID-19 2020 lockdown. A local adjustment in timing of patient's first follow-up and type of block during this pandemic is evaluated. As these changes were part of a risk management plan, ethics approval was not required.

Patients with closed distal radius fractures requiring manipulation were included. Consecutive sampling within each pandemic period was completed using the plaster room log book of MUAs to generate 30 patients prior to, during, and after lockdown in each group, with a short transitional time between periods. Pre-lockdown

**Table V.** Two by two contingency table for exposure to Bier's block.

Exposure	Complications, n	No complications, n	Total
Bier's block	5	41	46
Other	6	32	38
Odds ratio	$(5 \times 32)/(6 \times 41)$ $= 0.65$		

(P1) was assessed from February to March 2020 (retrospectively), lockdown (P2) as April to May (prospectively), and post-lockdown (P3) as July (prospectively). Patients were excluded if they had a moulded plaster only and sampling was terminated once 30 patients were identified per period.

Demographics, type of block, first and last follow-up, operation (if required), and primary and secondary endpoints were recorded. Both operative and nonoperative patients were assessed in the study and analyzed together unless otherwise stated.

Primary endpoints were early complications ( $\leq$  one week) including plaster cast pain, pressure sores, failure of MUA, or to identify volar displacement. Secondary endpoints were later complications, delayed union, malunion, osteotomy or secondary surgery.

**Statistical analysis.** Data was analyzed from the plaster room log book using Excel (Microsoft, USA) and Socscistatistics software 2021 (Social Science Statistics, USA). Patient ages within P1 to P3 are expressed as medians, patient follow-up categorized as percentages, and complications as individual incidence. Nonoperative and operative management, union rate, and type of block were measured using the chi-squared test between independent variables P1 to 3 with 2° of freedom and a significance level of 0.05. The odds ratio for Bier's block in comparison to other methods will be calculated using a 2 x 2 contingency table.

## Results

A total of 90 patients were included, of whom 67 (74%) were female and 23 (26%) were male. The median age of patients in P1 was 64 years (18 to 94), 66 years (30 to 91) in P2, and 65 years (32 to 86) in P3. Presence or absence of comorbidities did not affect choice of block between periods ( $p = > 0.05$ , chi-squared test). Loss to follow-up included two patients in P1, one patient in P2, and three patients in P3. These cases were still included in the early analysis of complications but secondary outcomes were adjusted. Follow-up was an average of six months (4 to 9).

Figure 1 depicts the changes in follow-up practice post-MUA during each pandemic period. During P1, 26/30 (86.6%), P2: 8/30 (26.7%), and P3: 17/30 (56.7%) patients were seen in the fracture clinic between days one and three following MUA, respectively. Of note, a total of 17/90 patients (18.8%) attended hospital three times

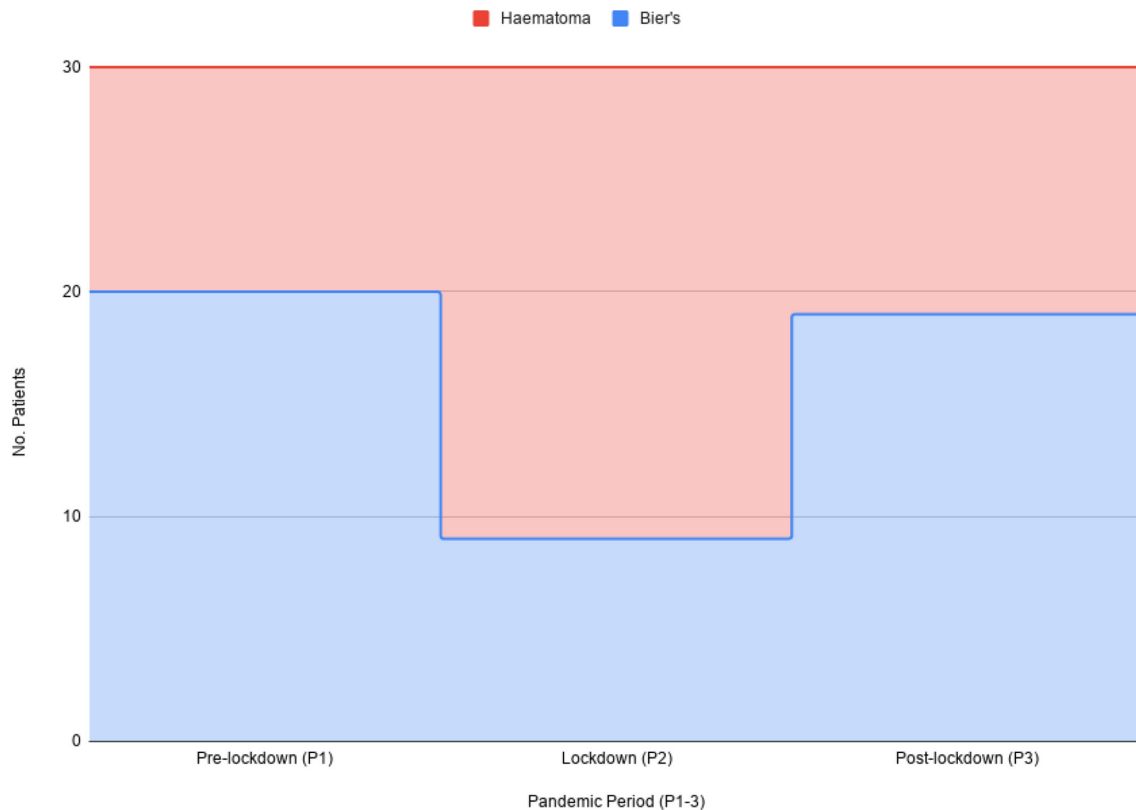


Fig. 2

Use of Bier's and haematoma blocks.

(A&E, MUA, first follow-up) within the first week of injury particularly during P3. This did not include the standard one-week follow-up.

Table I shows the number of operations performed in each pandemic period (P1 to P3) with reference from time of injury. Operation rate did not vary significantly between groups ( $2^\circ$ ,  $n = 90$ ) = 0.68,  $p = 0.712$ , chi-squared test). Operative management was performed during P1 in 12/30 patients (40%), P2 in 11/30 (37%), and during P3 in 9/30 (30%). The overall chance of having an operation for DDRF was 35.5%. There were no missed volar Barton fractures.

During P2, one patient (3.2%) was identified with a volarly displaced distal radius fracture, who was operated upon on day seven. Another patient during P2 declined an operation and subsequently required an osteotomy for malunion later in P2. From the earliest nonoperative case to the most recent (minimum four-month; maximum nine-month follow-up), there were no additional patients requiring osteotomy.

Table II provides a breakdown of complications with respect to timing and pandemic period. There were no early complications within the first three days post MUA. Primary endpoints occurred between days four to seven, with one patient (3.3%) being seen during each period for plaster cast pain only. One patient during lockdown

had a dinner fork deformity but continued nonoperative management to a healed malunion. Secondary endpoints occurred in one patient (3.3%) during P1, who had delayed union but went on to heal within nine months. One patient (3.3%) who had a malunion in P2 did not require further surgery. In P2, a grade 2 pressure sore from the plaster cast was identified more than two weeks following MUA and went on to heal with conservative measures. The osteotomy patient in P2 also had an ulnar cutaneous nerve injury, as well as one other P2 patient. During P3, there was one case of delayed union having ongoing follow-up.

Table III shows the union rate by pandemic period alongside nonoperative and operative management. Union rate in nonoperative compared to operative patients was not statistically significant ( $2^\circ$ ,  $n = 84$ ) = 0.53;  $p = 0.7768$ , chi-squared test). Union rate did not change by more than 1% between P1 to 3, regardless of intervention. The overall fracture union rate was 96%.

Table IV demonstrates the change in block practice between P1 and P3. The majority of patients (88/90 (97.7%)) had either Bier's block or haematoma block. One patient in P1 had Pentrox and another patient in P2 received Entonox. Pre-lockdown, 20/30 patients (63.3%) had MUA with Bier's block. During P2, only 9/30 patients (30%) has Bier's block. Post-lockdown, 20/30 patients

(63.3%) had Bier's block. Change in block practice was statistically significant with a  $p$ -value  $< 0.05$ . Figure 2 highlights the initial change followed by reversion in practice during the three pandemic periods.

The risk ratio of all complications (primary and secondary endpoints) with Bier's block, after adjusting for six patients lost to follow-up, was 0.65, suggesting a reduction in risk compared to other methods (Table V).

## Discussion

This study set out to investigate if a local risk reduction measure during the COVID-19 pandemic affected patient care and outcomes. The wider scope of the study was to determine if this change in practice could be safely sustained. The initial intention in removing the standard 72-hour follow-up post-MUA was to reduce the risk of patients contracting hospital acquired COVID-19. Another important function was to free up valuable clinic slots for other emergencies or accommodate lower staffing levels due to redeployment. In the context of the pandemic, changes in practise in the absence of rigid protocols are considered acceptable by the General Medical Council (GMC).<sup>8</sup>

The authors acknowledge that the study is underpowered, particularly in P2 during the intervention. The decision to move the first follow-up to one week was based on the experience of a large consultant body. The three pandemic periods represent an active oscillation from standard practice around the COVID-19 spike. In all 90 patients, early significant complications did not feature before one week, demonstrating that during this time a 72-hour follow-up did not influence complication rate.

The function of the 72-hour follow-up is to check the patient in a consultant-led clinic, which may be more beneficial in settings where the A&E department complete the MUAs. In our speciality-led set-up, this first follow-up does not require radiographs and therefore offers little additional value to the patient or surgeon. Admittedly, this may not be the norm; therefore, consideration of a one-week follow-up instead of 72 hours applies to speciality-led MUAs in a setting similar to described.

The results of this study showed that during the first three days post-MUA, in all pandemic periods, there were no recorded early complications or missed volar Barton fractures. If this is extended to the first week, plaster cast pain occurred in 3/90 patients (3.3%), who were managed by the plaster room nurses in line with BOA casting standards. Therefore, acknowledging that this is a snapshot view of practice during a significantly turbulent time, this early follow-up for the majority of patients did not identify any complications nor stimulate a change in management.

During P1 to P3, almost 20% (18/90) of patients were asked to return twice, in addition to their A&E presentation. Therefore, each will have attended hospital four

times on completion of their one-week follow-up, using a total of 68 slots. If the new measures were implemented on a long-term basis, this figure would halve to 34 clinic appointments. In the absence of demonstrating any increased risk within the first three days post-MUA, this raises the question of whether the 72-hour follow-up is required long-term.

Interestingly, the decision to operate seemed consistent across all three pandemic periods, with no statistically significant difference demonstrated. The concern at the time was that there may not be the operative capacity or staffing to support the usual numbers. This fortunately, with respect to DDRF, did not seem to be the case.

It is acknowledged that follow-up of patients in this study was limited to a maximum of nine months, which is not long enough to comment on whether the patients with delayed union went on to unite. The overall union rate within this time period at a mean follow-up of six months was 96%, with no statistically significant differences between nonoperative and operative patients from P1 to P3. There was a minor propensity for patient's to opt for nonoperative intervention during lockdown (2/30; 6.6%). It is imperative to ensure our patients have a full capacity assessment before applying a transparent consent process, establishing their objective understanding of the risk and benefits of each treatment option. There was no increased risk during lockdown of secondary fracture surgery at a minimum of four-month follow-up. In a multicentre, five-year follow-up study by Costa *et al*,<sup>9</sup> it was demonstrated that secondary surgery was uncommon.

This study site uses Bier's block as the gold standard for regional anaesthesia in distal radius fractures. Contraindications are severe hypertension (over 200 mmHg), peripheral vascular disease, sickle cell disease, severe Raynaud's disease, and crush injuries.<sup>10</sup> Locally, heart block is also a contraindication and cardiomyopathy a relative contraindication. Practically, the most common reason for not performing Bier's block was failure to find a vein in the injured limb due to swelling. Another reason during P3 where haematoma block was selected was in a patient with Parkinson's disease due to preferring a shorter procedure.

As a result of the Bier's block requiring close proximity of two plaster technicians and a junior doctor for around one hour, a local agreement to permit haematoma blocks was installed. Bier's blocks were still permitted in low risk cases or at the discretion of the senior surgeon. The dramatic reduction in the use of Bier's block between during lockdown (P2) provided a unique opportunity to review the technique with respect to outcomes. While primary and secondary outcomes did not change significantly between the three periods, the odds ratio of 0.65 for Bier's block suggests a protective exposure in Bier's block. The alternative inhaled analgesic methoxyflurane

(Pentrox) was chosen once in P1 in an intravenous drug user with mental health problems. In addition, nitrous oxide (Entonox) was used once in P2. Clinical justification for these alternatives should be documented.

While Bier's block is a resource-intensive procedure, it is considered to be superior in analgaesic properties and therefore permit more accurate fracture reduction. It also offers unique training opportunities for junior doctors, in particular the junior trainees, who enjoy the responsibility and practical application of the skill.

It is important to consider the wider implications of these results by examining further limitations of this study. It was predominantly retrospective, therefore at risk of information bias. The study period was limited to six months involving only 90 patients, which is relatively low considering the incidence of this injury. The period in question (P2) from which we draw these observations is particularly underpowered. The junior doctors who managed the MUAs were not rotated therefore retained in service for the whole audit period due to the pandemic. This meant they had more experience than usual in the management of this injury due to sustained exposure. Consequently, this may have improved outcomes particularly in the nonoperative patients. Multicentre evaluation of DDRFs is required in order to further inform future practice.

Follow-up of our patients with DDRF at one week following MUA did not expose them to additional risk of primary or secondary complications nor affect outcomes. In addition, Bier's block may offer some protective exposure when compared to other methods. Application of this change outside of the COVID-19 lockdown may also be more convenient for patients. In addition, these results support further rationalization for the provision of trauma clinic appointments.



### Take home message

- A pragmatic approach can inform future patient management.
- Regional anaesthesia may reduce complications.

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- B. J. Varghese: Conceptualized and designed the study, Acquired, analyzed, and interpreted data, Responsible for the integrity and accuracy of the data analysis, Revised method in the manuscript.
- D. M. Hahn: Responsible for the integrity and accuracy of the data analysis. Supervised and revised the manuscript.

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