

# Colles' type distal radial fractures undergoing manipulation in the ED: a multicentre observational cohort study

Hamza Malik ,<sup>1</sup> Andrew Appelboam,<sup>1</sup> Gordon Taylor<sup>2</sup>

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<sup>1</sup>Emergency Medicine, Royal Devon and Exeter NHS Foundation Trust, Exeter, UK  
<sup>2</sup>Medical Statistics, RDS SW, University of Exeter Medical School, St Luke's Campus, Exeter, UK

## Correspondence to

Dr Hamza Malik, Emergency Medicine, Royal Devon and Exeter NHS Foundation Trust, Exeter EX4 3BZ, UK; [hamza.malik1@nhs.net](mailto:hamza.malik1@nhs.net)

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## ABSTRACT

**Background** Colles' type fractures of the distal radius are one of the most commonly manipulated fractures in the ED. Local audit data suggest that a high proportion of these injuries undergo subsequent surgical fixation. If widespread, this could represent a potential burden on patients and the NHS worthy of further research. The aims of this study were to estimate the rate of surgical fixation of Colles' type distal radial fractures after ED fracture manipulation and explore variations in their management in UK EDs.

**Methods** We conducted a multicentre observational study in 16 EDs in the UK from 4 February 2019 to 31 March 2019. All adult patients with a Colles' fracture who underwent fracture manipulation in the ED were included. Patients who could not be followed up and those with volar displaced fractures were excluded. We measured the rate of wrist fracture surgery at 6 weeks, patient demographics and variations in anaesthetic technique used.

**Results** During the study period, 328 adult patients attended the participating EDs with a distal radial fracture. Of these, 83 patients underwent fracture manipulation in the ED and were eligible for the study. Their mean age (SD) was 65.3 (17.0) years, 84.3% were female and the most common method of anaesthesia used was haematoma block (38.6%). 34 (41.0%, 95% CI 30.3 to 52.3) patients had subsequent surgical fixation of their fracture. Younger age was associated with higher rates of surgical fixation but ED anaesthetic technique did not affect the subsequent need for surgery in this sample.

**Conclusion** Subsequent surgical fixation was carried out in 41% of patients who underwent manipulation of Colles' type wrist fractures in this cohort. This merits further research and represents a potential target to rationalise repeat procedures.

## INTRODUCTION

Colles' type distal radius fractures are among the most frequently manipulated fractures in the ED. First described by Abraham Colles in 1814,<sup>1</sup> they are classified as dorsally displaced, metaphyseal, extra-articular distal radius fractures.<sup>2</sup> In the UK, they account for nearly one-sixth of all fractures presenting to the ED,<sup>3</sup> with approximately 71 000 men and women suffering from a distal forearm fracture each year.<sup>4</sup> They are the most common upper limb fragility fracture in the elderly, usually occurring as a consequence of a fall onto an outstretched hand<sup>5,6</sup> with a rising incidence across

## Key messages

### What is already known on this subject

- Colles' type distal radius fractures are among the commonest manipulated fractures in the emergency department (ED).
- Local audit and a Dutch study showed that the subsequent surgical fixation rate of these fractures can be up to 40%. This study was done to determine the surgical fixation rate after Colles' type fracture manipulation in the ED and explore variations in emergency department management of these fractures across the UK.

### What this study adds

- Colles' type of distal radius fractures undergoing ED fracture manipulation accounted for approximately 25% of all distal radial fractures presenting to participating EDs.
- Surgical fixation of Colles' type of distal radius fractures after ED fracture manipulation in UK EDs studied occurred in over 40% of cases. Haematoma block was the most frequent anaesthetic technique used.
- Further studies could explore this high surgical rate and assess whether changes to ED management could reduce the need for surgery and be of benefit to patients.

the world due to an increasing age demographic.<sup>7</sup> Tailored organisation of emergency care for the elderly constitutes one of the top 10 research priorities according to the Royal College of Emergency Medicine<sup>8</sup> and research into the management of wrist fractures requiring manipulation was highlighted in a recent research priority setting partnership, focused on upper limb fractures in people over 50 years of age.<sup>9</sup>

Despite manipulation of these fractures in the ED to correct deformity and apply cast immobilisation, patients may go on to need surgical fixation of their wrist either due to an inadequate initial position or secondary displacement of the fracture, typically within 6 weeks of injury. Local audit data suggested that as many as 25%–40% of patients undergoing manipulation go on to have surgery,<sup>10</sup> but the rate in other UK centres is unknown. With repeated visits to hospital, surgical costs (an open reduction and volar locking plate fixation costs £2212<sup>11</sup>) and possible



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surgical complications, this represents a substantial burden to patients and health services. However, at least in the elderly, surgical fixation of distal radius fractures does not necessarily provide better clinical outcomes, has a greater risk of complications when compared with non-surgical management<sup>12</sup> and there is consensus for non-operative treatment for adequately reduced fractures.<sup>13</sup>

In the ED, the type of anaesthesia, quality of initial fracture reduction and adequacy of cast immobilisation could all influence the subsequent rate of surgery. Although Bier's block anaesthesia has been shown to be superior to haematoma block and is recommended by the National Institute for Health and Care Excellence (NICE),<sup>14</sup> it was used less frequently than haematoma block and procedural sedation in a recent UK survey.<sup>15</sup> Wrist fracture manipulations in the ED are typically done 'blind' in UK without real-time imaging. Assistance through mini c-arm or point-of-care ultrasound to guide the reduction of these fractures in ED<sup>16 17</sup> has been suggested but neither are in widespread use and research into their utility has been advocated by NICE.<sup>14</sup>

Designing studies to address these areas of research requires an up-to-date knowledge of the incidence of Colles' type of distal radial fractures, the proportion currently undergoing ED manipulation under anaesthesia (MUA) and the subsequent rate of surgical fixation together with an understanding of current practice. This study therefore aims to estimate the proportion of Colles' type distal radius fractures undergoing ED MUA in the UK, estimate the rate of post-ED MUA surgical fixation, describe the variation of anaesthesia currently used for these manipulations in UK EDs and provide feasibility data for future studies such as availability and use of real-time imaging to guide ED fracture reduction.

## METHODS

### Study design

We conducted a prospective observational cohort study according to Strengthening the Reporting of Observational Studies in Epidemiology guidelines.<sup>18 19</sup> Patients were recruited from 4 February 2019 to 17 February 2019 and followed up for 6 weeks.

### Subjects and setting

Using previous local ED audit data suggesting an incidence of 2.5 eligible MUA patients per week per centre and a surgical rate of 25%, it was estimated that a 2-week case identification period in around 20 participating sites would provide a convenience sample of around 100 patients with a reasonable point estimate of surgical rate, while allowing completion of the study and follow-up within a practical time period and the available study resources.

All adult patients presenting to participating EDs with a distal radial fracture were identified over a 2-week period (4 to 17 February) through radiology and ED attendance databases. From these cases, all patients with Colles' type of distal radius fractures undergoing manipulation in ED were identified through a structured ED notes review and screened for eligibility according to the criteria for inclusion and follow-up.

### Inclusion criteria

All adult patients aged 18 years and over, with a confirmed Colles' type distal radial fracture undergoing wrist fracture manipulation in the ED, were included.

### Exclusion criteria

Patients aged <18 years, those with a volar displaced (eg, Smith's) fracture or those where follow-up data were not available, were excluded.

Basic demographic data, the method of anaesthesia used for each MUA and any record of the presence of an open fracture or neurovascular compromise were recorded. Participants were then followed up for 6 weeks from the initial manipulation in ED to identify the occurrence of any surgical fracture fixation during that time by screening fracture clinic, theatre registry and hospital discharge notes.

EDs across the UK were approached to participate where medical students, undertaking an intercalated BSc degree in Urgent and Emergency Care from the University of Plymouth, were on a clinical placement. Study data were primarily collected through this intercalated BSc student network.

The students and their supervisors were sent detailed instructions for data collection, the study protocol and a standardised password-protected, data collection spreadsheet (Excel 2010). Sites were instructed to register the study with their respective research and development or audit departments prior to the commencement of data collection. Support and advice was available from the study team for the duration of the study with follow-up of any missing data by the chief investigator via email, to ensure data completeness and accuracy.

### Data collection and analysis

Completed data collection spreadsheets were emailed to the study team by NHS email. No patient identifiable information was sent. The data were analysed using IBM SPSS Statistics V.20. Descriptive statistics were used to report all variables, with 95% CI. Chi-square test was used to determine significance between proportions. A p value <0.05 was deemed statistically significant.

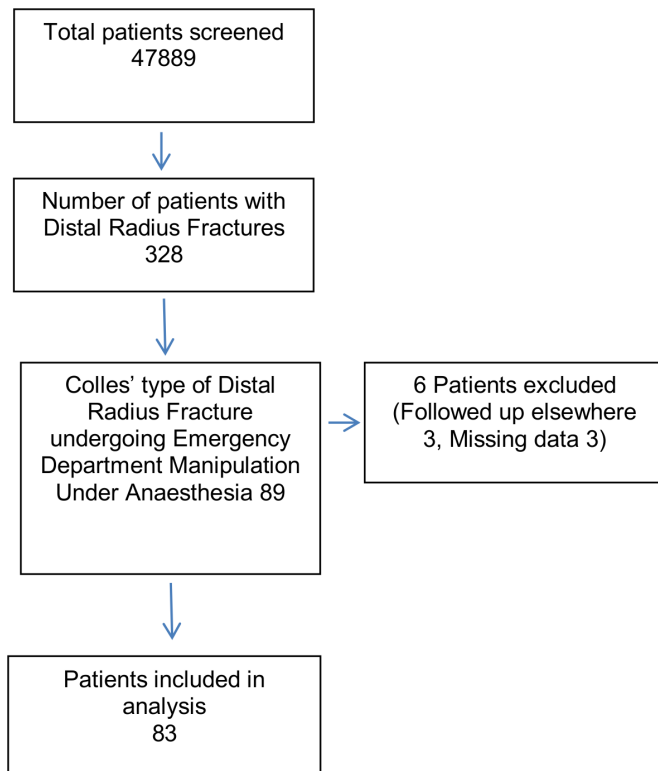
## RESULTS

Students and staff in 16 hospitals agreed to contribute to this study. Participating sites are listed in online supplementary appendix 1. Data were collected by BSc students in 10 EDs and junior doctors working in the remaining 6 EDs.

### Incidence of ED MUA and subsequent surgical fixation

Three hundred twenty-eight patients with distal radial fractures were identified and screened from 47 889 patients presenting to participating EDs during the 2-week case identification period. Eighty-nine patients initially met the eligibility criteria but three patients were subsequently followed up elsewhere and data were missing in a further three patients. A total of 83 patients (25% of all distal radial fractures seen) therefore underwent ED MUA, had follow-up data available and were included in the study (figure 1). This represented two to three patients per department per week. The mean (SD) age of patients undergoing ED MUA was 65.3 (17.0) years and 70 (84.3%) were female.

Of the 83 eligible patients undergoing ED MUA for Colles' type wrist fracture, 34 (41.0%, 95% CI 30.3 to 52.3) went on to have surgical fixation within 6 weeks. The number of MUA cases reported by each centre varied from 1 to 17 with a median surgical rate of 50% (IQR 23.5%–66.7%). Three patients were recorded as having an immediate need for MUA such as neurovascular compromise, threatened skin or an open fracture and of these, two patients subsequently underwent surgical fixation. Excluding these patients from the analysis did not significantly change the surgical fixation rate (40%). Also, assuming all or



**Figure 1** Screened and selected patients.

none of the six patients that were lost to follow-up had subsequent surgery would result in a surgical fixation rate between 31% and 45%.

### Methods of anaesthesia

Thirty-two (38.6%) of the cases were manipulated after a haematoma block and 24 (28.9%) were undertaken using Bier's block anaesthesia. Although post-ED MUA surgical rates varied with the type of anaesthesia used, with the highest percentage (46.9%) seen with haematoma block, these differences were not statistically significant in this relatively small cohort (table 1).

### Other findings

Younger age was associated with post-ED MUA surgical fixation of the fracture with a mean age of  $71.2 \pm 13.8$  years for patients who did not require surgical fixation compared with  $59.06 \pm 15.8$  years for those who did ( $p=0.01$ ). Post-ED MUA surgical rate had no significant relationship with gender ( $p=0.055$ ). An

**Table 1** Post-ED MUA surgical rates with different anaesthetic techniques

Anaesthetic technique	Post-ED MUA surgery (number of patients (%))		Total (%)
	Yes	No	
Haematoma block	15 (46.9)	17 (53.1)	32 (38.6)
Bier's block	7 (29.2)	17 (70.8)	24 (28.9)
Intravenous sedation	7 (50)	7 (50)	14 (16.9)
Other*	5 (38.5)	8 (61.5)	13 (15.7)
Total	34 (41.0)	49 (59.0)	83 (100)

\*Other included intravenous morphine, nitrous oxide and oxygen (Entonox) and methoxyflurane;  $\chi^2=2.35$ ,  $p=0.50$ . MUA, manipulation under anaesthesia.

ultrasound machine was available in all EDs but no participating ED was routinely using it (or any other real-time imaging) to guide manipulation of Colles' type fractures.

### DISCUSSION

We conducted an observational cohort study of patients presenting to 16 hospitals across the UK to identify and follow-up patients undergoing manipulation of displaced Colles' type distal radial fractures in the ED. This is a common injury, representing a quarter of all distal radial fractures seen in participating centres and the manipulation of >80 fractures in 2 weeks. The proportion of these patients that went on to have surgical fixation of their wrist after ED MUA was 41.0%, with over one in three patients undergoing surgery within 6 weeks. This rate of surgery, extrapolated to all EDs in the UK, would represent over 10 000 operations per year. Together with the initial ED episode and subsequent hospital visits, this represents a substantial burden for patients, carers and the health service. Our results are consistent with previous local audit data and the findings of another European study.<sup>10 20</sup> The observed rate remains clinically important at both the lower confidence limit of our estimate and after a sensitivity analysis taking into account those who could not be followed up or discounting the small number with clear indications for surgery such as an open fracture.

There are a number of factors that could increase the rate of post-ED MUA surgical fixation. These include inadequate initial reduction (due to technical or anaesthetic limitations), unstable fractures that subsequently slip, insufficient cast immobilisation and variations in patient demographics, fracture patterns and surgical decision making.

In our study, haematoma block was used in 38.6% of cases. This is lower than reported by Sprot *et al* in 2012,<sup>15</sup> but this is a technique that has been shown to be less reliable in reduction of Colles' type fractures with more pain and lower quality reductions<sup>20 21</sup> compared with Bier's block intravenous regional anaesthesia.<sup>14 22</sup> Although cases managed with a Bier's block were associated with the lowest rate of surgery in this cohort, the difference was not statistically significant. Whatever technique is employed, it is possible that inadequate anaesthesia could affect the quality of fracture reduction and increase the risk of subsequent surgery.

As is common practice in the ED, the reductions in this cohort were done without real-time imaging such as ultrasound or c-arm. These have been used in some studies to guide reduction of Colles' type fractures in ED and may improve fracture reduction position and the rate of subsequent surgical fixation.<sup>23</sup> Point-of-care ultrasound was available in every participating ED, but was not routinely used to guide fracture reductions in these departments. Given the availability, safety and familiarity of point-of-care ultrasound scanning among emergency physicians, this is a potential area for further study.

The higher incidence of surgery in younger patients seen in this study may reflect variations in surgical decision making or, more likely, due to the different injury patterns and greater risk of fracture instability seen in this group.<sup>24</sup> However, there are no universally accepted or standardised criteria for determining the need for surgery in distal radial fractures. There is debate as to who should be offered surgery and there is a randomised trial assessing theatre-based closed reduction versus surgical fixation currently underway.<sup>25</sup>

Our study was largely conducted and delivered through a novel network of students. They identified over 300 patients with a distal radial fracture over the study period, using a

standardised case identification protocol with a high rate of data completeness and follow-up (97%). This efficient network has been able to provide important data to inform further research, in a very short space of time, at low cost, and is a research model that could be considered in the future.

Only 16, non-randomly selected, training departments took part and there is a risk that they may not be fully representative of overall UK practice. However, they reflect a range of ED sizes with a wide geographical spread and links with training and academia that are often a marker of clinical quality. It might be argued therefore that the observed results might even represent an optimistic estimate of the rate of post-ED MUA surgery. We also used a convenience sample in this exploratory study without a formal sample size calculation and did not power the study to identify which factors might have influenced the rate of surgery. Although slightly fewer centres took part than planned, the CI of the estimate of surgical rate remains clinically meaningful.

We made no assessment of factors such as the adequacy of ED fracture reduction, the quality of cast immobilisation, variation of fracture pattern or functional outcome. We also did not explore the variation in surgical rates between the different centres. Assessing these variables would require much larger and more complex studies that could be conducted in future. Other potential sources of bias inherent in observational ED studies include limitations of diagnostic coding, errors of data entry and failure to identify all eligible cases.<sup>26</sup> However, collaborators were instructed and encouraged to access at least two sources to identify potential patients, used defined eligibility criteria and standardised data entry tools, and were supervised and supported as far as possible.

This observation cohort study has demonstrated a high rate of surgical fixation of Colles' type wrist fractures in patients after initial fracture manipulation in EDs across the UK, with over 40% going on to receive surgery. It is not currently clear whether reducing the rate of post-ED MUA surgery is possible, or indeed beneficial. However, given many patients are effectively undergoing two procedures (with their associated costs, risks and burdens), this is an area worthy of further research.

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**Contributors** HM conceived the original idea for this study, conducted the original study, undertook data analysis, write-up of the first draft and subsequent revised versions and approved the final version for publication. AA conceived the original idea for this study, supervised the conduct of the study, supervised the production of the manuscript, contributed to the initial draft and subsequent revised versions and approved the final version for publication. GT supervised the production of the manuscript, contributed to the initial draft and subsequent revised versions and approved the final version for publication.

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**ORCID iD**

Hamza Malik <http://orcid.org/0000-0001-7937-837X>

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